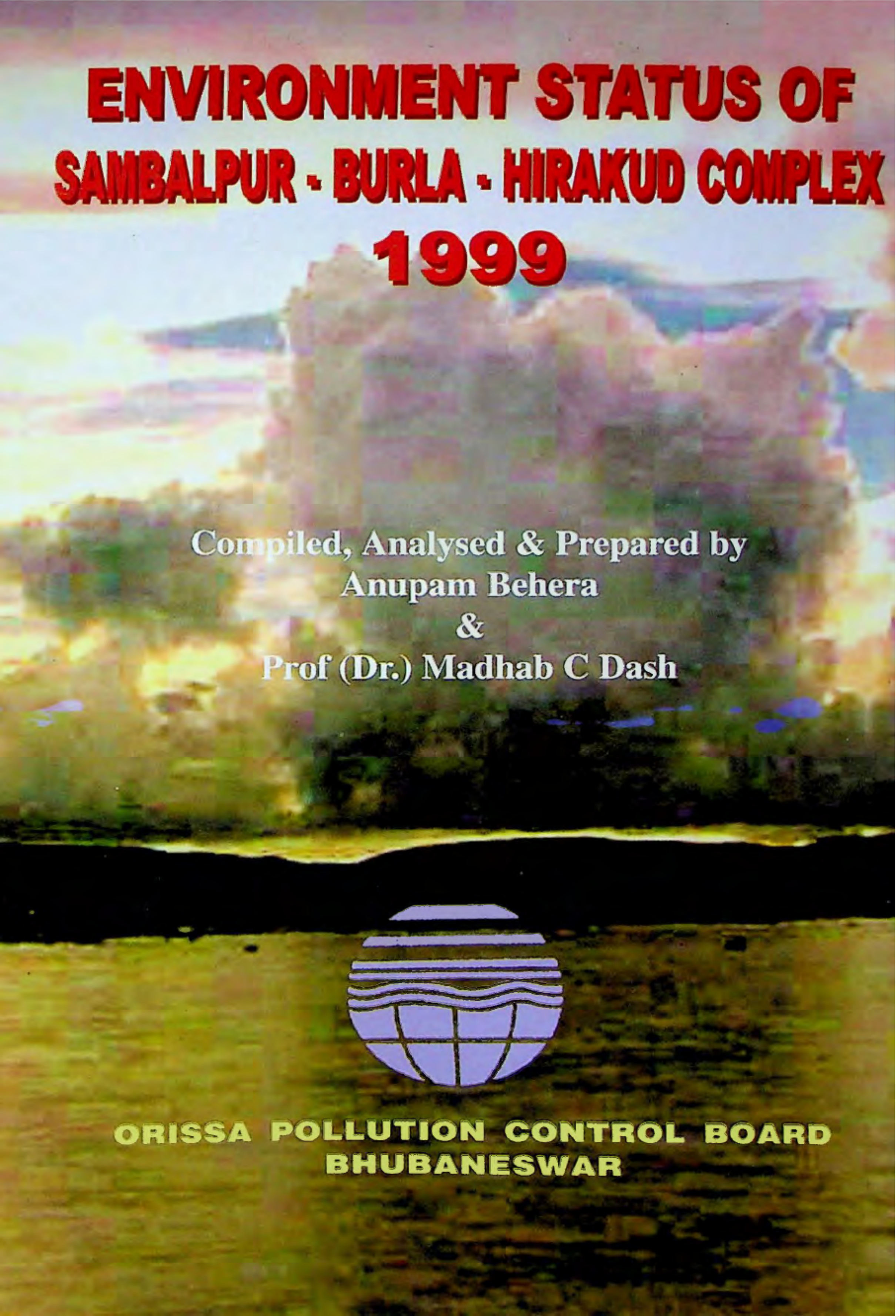


ENVIRONMENT STATUS OF SAMBALPUR - BURLA - HIRAKUD COMPLEX

1999

Compiled, Analysed & Prepared by
Anupam Behera
&
Prof (Dr.) Madhab C Dash

ORISSA POLLUTION CONTROL BOARD
BHUBANESWAR

ENVIRONMENT STATUS OF SAMBALPUR - BURLA - HIRAKUD COMPLEX

1999

Compiled, Analysed & Prepared
by
Anupam Behera
REGIONAL OFFICER, SAMBALPUR
&
Prof (Dr.) Madhab C Dash
CHAIRMAN
ORISSA POLLUTION CONTROL BOARD

ORISSA POLLUTION CONTROL BOARD
BHUBANESWAR

OPCB / 1000 / 1999
Public Awareness Series / 5 / 1999
Copyright © OPCB
Price Rs. 100.00

EDITORIAL BOARD

Prof. Madhab C. Dash, Chairman	Chief Editor
Dr. Maheswar Patra, Member Secretary	Managing Editor
Dr. D. K. Rout, Environmental Scientist	Editorial Board Member
Er. N. R. Sahu, Environmental Engineer	Editorial Board Member
Sri S. K. Prusty Asst. Environmental Scientist	Editorial Board Member

NATIONAL POLLUTION PREVENTION DAY

2nd December 1999

Published by
Member Secretary, Orissa Pollution Control Board, Bhubaneswar

Cover designed by Sri T. K. Mishra & Sri N. R. Rout

PREFACE

Environmental pollution has become serious in urban areas and in industrial towns due to municipal solid waste and sewage automobile exhausts, industrial emissions and effluent discharge. In recent times the problem has been aggravated due to solidwaste and bio-medical wastes in urban centres and industrial areas. Rural India suffers mainly from SPM (Suspended particulate matters) due to bad roads and also water pollution. Sambalpur is an ancient town and in recent times many major medium and minor industries have come up. The area has immense potential of water resources and energy resource, because of availability of coal in IB Valley and water in Mahanadi River system. Phenomenal industrial growth has occurred in Sambalpur region because of these reasons. The region has also very rich in biological diversity, specially in Gandhamardhan Hill ranges, Ib valley, Ushakothi Sanctuary region. Considering the problem environmental degradation due to mining activities and industrial pollution, Orissa Pollution Control Board through its Sambalpur Regional Office has prepared a report on the "ENVIRONMENTAL STATUS OF SAMBALPUR-BURLA-HIRAKUD COMPLEX". This report will form the base paper for future impact assessment and action plans. In the compilation and analysis of data, support of Sri D.Gouda, Mrs R.B.Samal, Sri S.N. Nanda , Sri A.Panigrahi and Sri S.Sahu of Sambalpur Regional Office of the Board are appreciated. Dr M.Patra, Member Secretary, Dr D.K.Rout, Environmental Scientist-II , Sri S.K.Prusty, Assistant Environmental Scientist have taken keen interest on this project . Dr. Niranjan Behera of Sambalpur University provided some data on Bio-diversity. I am sure this publication provides valuable information to Industrialists, Scientists, Administrators, Planners and persons interested in maintaining clean environment of Orissa.

Indal, Hirakud has helped in the publication of this valuable book and I wish to record my appreciation to Indal, Hirakud and Mr A.K.Kar, General Works Manager and Mr Rabindra Mishra, Works Manager for their keen interest.

Madhab C.Dash
Chairman,Orissa Pollution Control Board,
Bhubaneswar

TABLE OF CONTENTS

CHAPTER-1 GEO-ENVIRONMENTAL STATUS Page 01-14

- *Geographical Setting*
- *Area and Population*
- *Climate*
- *Temperature*
- *Geology*
- *Relative Humidity*
- *Wind Speed &Direction*
- *Groundwater Potential*
- *Soil*

CHAPTER-II SOCIO-ECONOMIC ENVIRONMENT Page 15-24

- *Existing Land Use Pattern*
- *Existing Occupational Pattern*
- *Utilities& Services*

CHAPTER-III AIR ENVIRONMENT Page 25-50

- *Ambient Air Quality*
- *SAAQM Station*
- *Critical Area*
- *Evaluation of AQI*
- *Ambient Noise Level*
- *Vehicular Pollution*
- *Traffic Census*
- *Traffic Noise*

CHAPTER-IV WATER ENVIRONMENT Page 51-68

- *Surface Water Bodies*
- *Lentic Water Bodies*
- *Ground Water Bodies*
- *Waste water Quality*
- *Industrial Effluent & its effect*

CHAPTER-V URBAN SOLID WASTES Page 69-78

- *Sources*
- *Quality*
- *Composition*
- *Constituents*
- *Method of Collection, Transportation and Disposal*

CHAPTER-VI INDUSTRIAL ENVIRONMENT Page79-86

- *Industrial Activities in the Urban Complex*
- *Air Polluting Activities*
- *Solid-waste Generating Activities*

CHAPTER-VII BIO-DIVERSITY Page87-102

- *Forest Cover*
- *Vegetation*
- *Faunal Diversity*

CHAPTER-VIII HEALTH STATUS Page 103-106

- *Health Profile*
- *Water-borne Disease*

CHAPTER-IX RECOMMENDATIONS &CONCLUSION Page107-110

- *Important Suggestions*

REFERENCES Page 111-112

CHAPTER - I

GEO-ENVIRONMENTAL STATUS

GEOGRAPHICAL SETTING

Sambalpur

Sambalpur is the principal town and administrative Head-quarters of Sambalpur district. The town derives its name from Goddess Samalei who was installed as Sambalpur's tutelary deity by Sri Balaram Dev, the 1st king of Chauhan dynesty which ruled in the 14th century.

Sambalpur, the principal urban center of the district is situated at the latitude of 21° 28' N & longitude 83° 58' E and has a mean elevation of 148.1 M (486') to 156.3 M (513') above the sea level.It lies on the north bank of river Mahanadi. It falls in the Calcutta-Bombay National Highway (NH-6) and is connected with N.H. – 42 (Sambalpur - Cuttack) .It is also connected by Rail to Calcutta-Bombay route & Raipur-Visakhapatnam route and Jharsuguda-Titilagarh line. There is a train direct to New Delhi from Sambalpur via Bilaspur-Katni.The distance of state capital, Bhubaneswar is 314 Kms by road. The physiography of Sambalpur Master Plan area is undulating.The ground slopes from North to South with a few rock out-crops protruding here and there. The ground slopes varies from a height of 460' to a height of 796' R.L. The area under the Municipality is 11484.54 Acres or 46.48 sq. Kms. The total Master Plan area is 23641.16 Acres or 95.68 sq. Kms out of which Motijharan, Lamdungri & Budharaja reserve forest (R.F) cover 156.60 Acres, 830.30 Acres, 127.10 Acres respectively. The total area under three reserve forest is 1114.00 Acres. The climate of Sambalpur is hot, humid and tropical. There are four distinct seasons during the year i.e. Summer (March to Mid June), Monsoon (mid June to September), Post-monsoon (October to Mid November) and Winter (Mid November – February). The rainfall is due to South-West monsoon. The average rainfall is roughly 1538.20 mm (60.5"). The heaviest rainfall occurs during July and lowest rainfall occurs in winter which is due to North-East monsoon. The average mean daily maximum temperature during April, May, June is of the order of 45.2° C (113.5° F) and the average mean daily minimum temperature is 6.4°C(43.52° F) during December, January and February (1993-1999).

The prevailing wind is from South (South – West and South from April to August) and from North (North-East and North from September to March). The weather at Sambalpur is comparatively calm from January to March. The velocity of wind is maximum during rainy season, especially in the month of July. The mean relative humidity varies from 48% to 87 % at 8.30 hrs and 27 % to 83 % at 17.30 hrs.

Burla

Burla town is located at 21° 30' N latitude and 83° 53' E longitude. It falls on the right bank of the Hirakud Dam project and has been constituted into a Notified Area Council (NAC) in 1962. At present it acts as a premier institutional town of Orissa with more than 30 years old Sambalpur University, 40 years old Medical College and 42 years old University College of Engineering at Burla. Besides the office of Hirakud Dam Reservoir it serves as a satellite town of Sambalpur. Presently Burla forms an urban component of Sambalpur urban agglomeration which is located 16 Kms South - East direction, Hirakud town in the north 5 Kms away.

Burla town has undulating land feature and surrounded by hilly terrain. Its elevation from sea level varies from 485' to 605'. A portion of land mass falling in the eastern part of

Bukamundi Mouza has the lowest elevation of 485' whereas the University campus falling in Burla, Gulgunda and Katapali Mouza has the highest elevation of 542' to 605'. The contour of water logged area due to power channel in Gulgunda and Bukamundi Mouza ranges from 505' and 510' above the sea level. In the town area the contour is from 550' to 555' which varies between 510 ' to 530 ' above the sea level around Engineering College and its campus.

The climatic condition in Burla is influenced by the presence of Hirakud Reservoir in the North-West, Chandli Dungri Reserve Forest (partly deforested) in the Western side and Laxmi Dungri reserve forest (deforested) in the North-Eastern side.

Burla Master Plan area (Fig:I-2) comprises of Burla NAC and one adjoining village namely Amsarha Katapali and covers an area of 9047.82 Acres. The urban segment of Master Plan area is the conglomeration of four revenue villages viz. Bokamundi No: 29, Kiriba No: 30, Burla No: 37 and Gulgunda No: 32 and covers an area of 5253.65 Acres excluding the river area of 1004.85 Acres. A. Katapali No: 33 constitute the rural sector with an area of 2789.32 Acres.

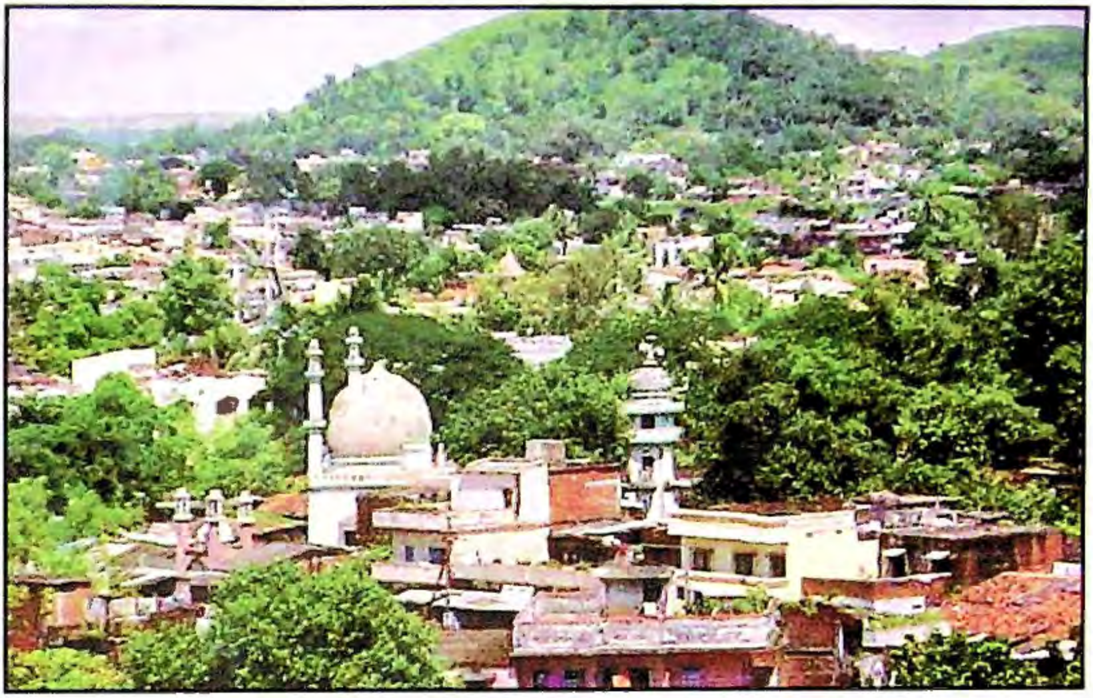
Hirakud

Formerly a small island termed Hirakud lying between two branches of river Mahanadi, about 16 Kms North of Sambalpur is the treasure of prosperity on account of Hirakud Dam and its associated functions. Hirakud was constituted as NAC in 1962. Hirakud is located 21° 31' North latitude and 82° 54' East longitude. The township is connected by motorable road with Sambalpur. Functionally Hirakud is an Industrial town and forms an urban component of Sambalpur urban agglomeration. Hirakud falls in Sambalpur Sub-Division which is characterised by undulating land with elevation varying from 146 M to 288.6 M above sea level. The general slope of the soil is from north to south and is broken up by ragged ranges of hills and is traversed in all direction by drainage channel mostly leading from the hill ranges to the Mahanadi and its tributaries. The climate of Hirakud is characterised by hot-dry summer extending from March to mid-June and followed by South-West monsoon rains from mid-June to September. The winter extends from December to February. The average annual rainfall varies between 1312-1662 mm. The atmospheric temperature rises to its maximum between 45° to 48° C during May and falls down to a minimum between 7° to 10° C during December.

The Hirakud Dam Project which is of great importance to Orissa was constructed in 1957. It is a multipurpose project with the objective of flood control, irrigation, generation of electricity, navigation, Soil conservation etc. It is the largest earthen dam in the World having reservoir of 6.6 million acre feet. The Master plan area of Hirakud is presented in Fig:I-3.

Sambalpur – Burla - Hirakud Complex

Sambalpur- Burla - Hirakud complex comes under the Sambalpur Development Authority (SDA) and this complex is the study area of this report (Fig:I-1).



PANAROMIC VIEW OF
SAMBALPUR TOWN

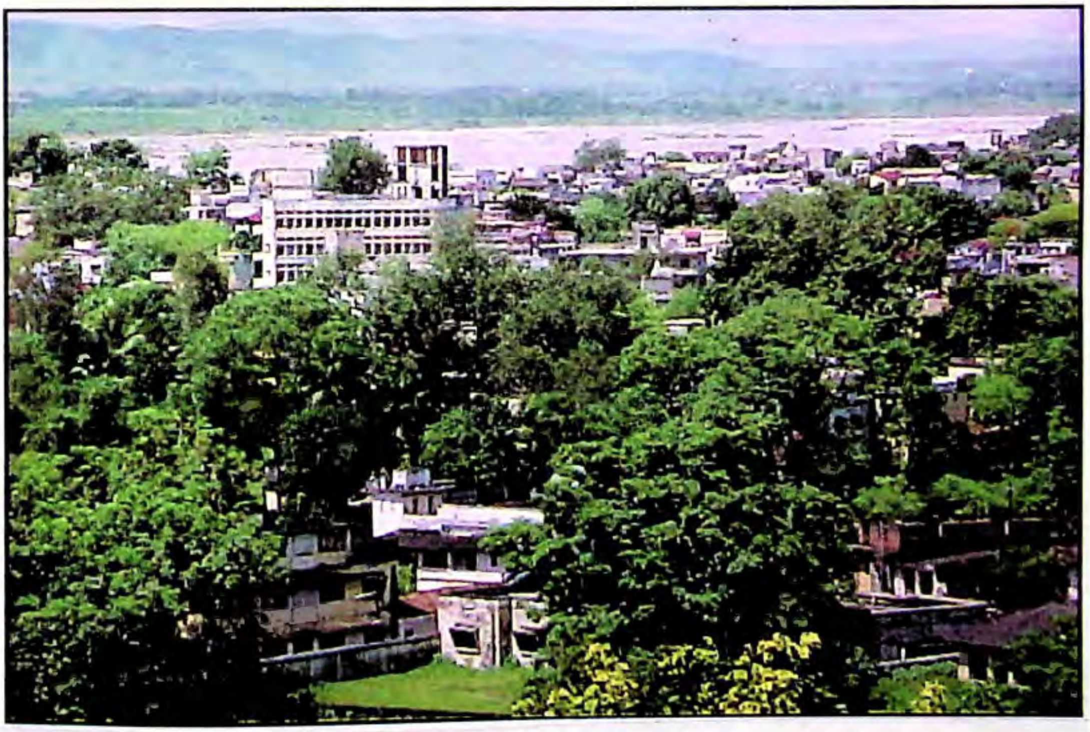
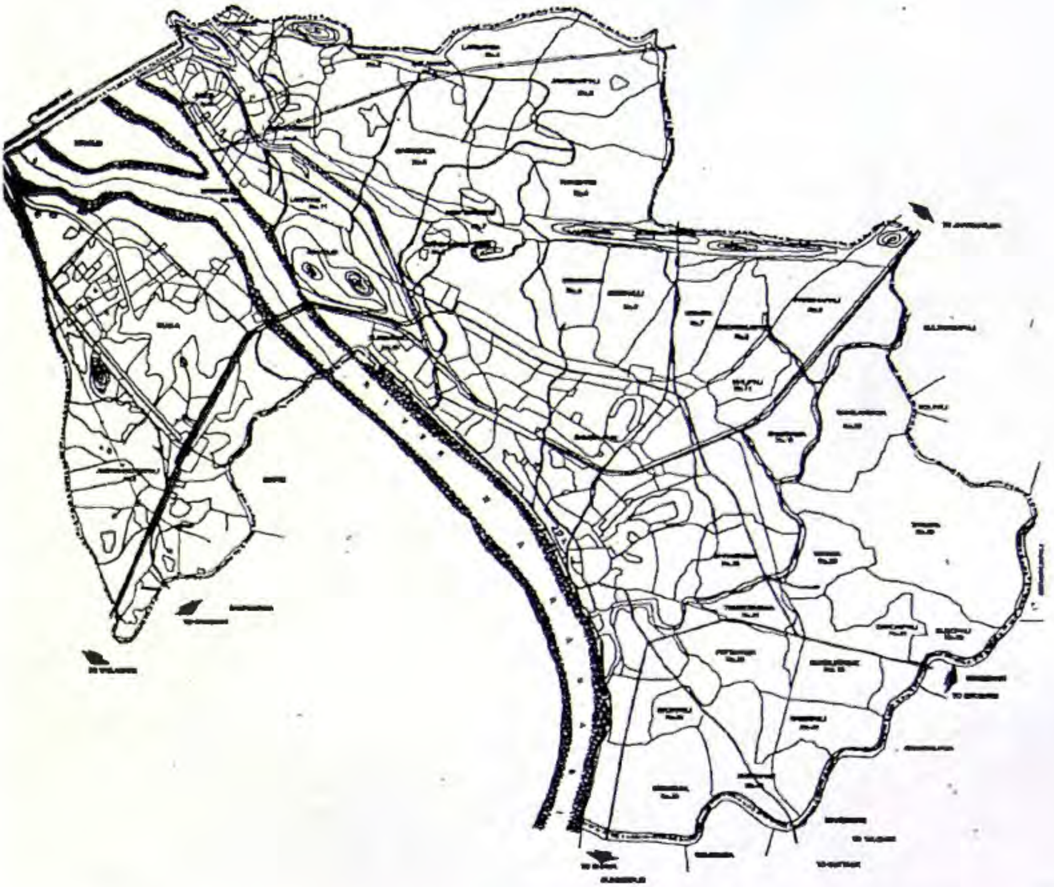


Fig:I-1: Map of Sambalpur – Burla – Hirakud Complex

Fig : I-1 : Map of Sambalpur-Burla-Hirakud Complex



SAMBALPUR-BURLA-HIRAKUD COMPLEX

Fig : I-2 : Master Plan of Burla

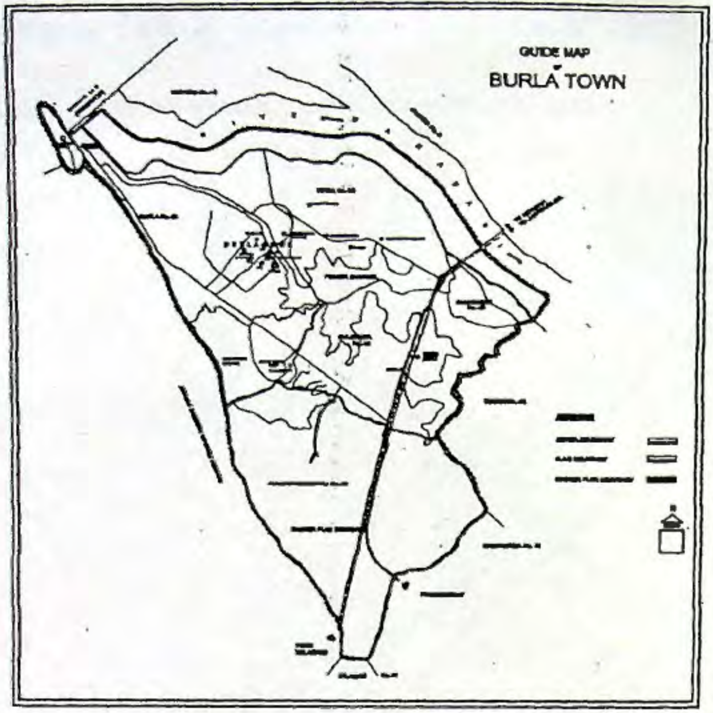
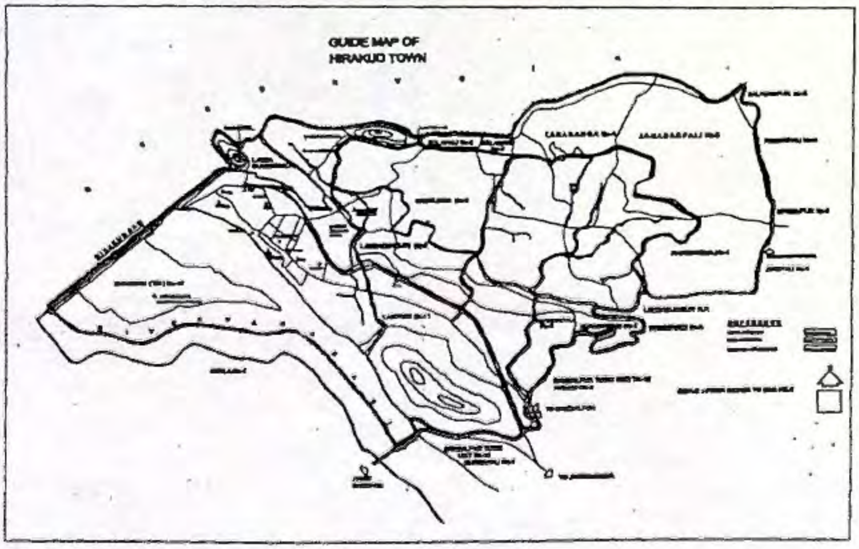


Fig : I-3 : Master Plan of Hirakud



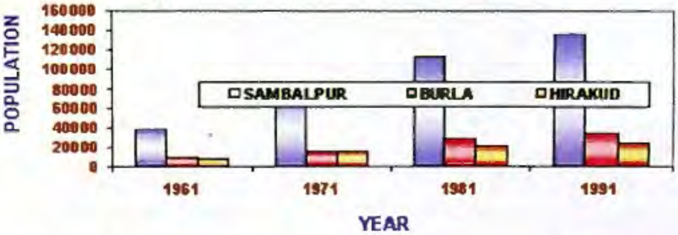
AREA & POPULATION

While considering sustainable development, population plays an important role and is directly related to environment. The Census data (collected from District Statistical Hand Book and from Master Plans of Sambalpur, Burla and Hirakud) on demographic profile are presented in Table : I -1 and Table : I - 2.

Table: I-1: Population Recorded During Census

YEAR OF ASSESSMENT	SAMBALPUR(M) & ITS OUTGROWTH	BURLA NAC	HIRAKUD NAC
1901	12870	-	-
1911	12981	-	-
1921	13594	-	-
1931	15017	-	-
1941	17079	-	-
1951	23525	-	-
1961	38915	10230	8593
1971	74458	15587	15040
1981	112631	27882	21071
1991	134824	34640	23833

Fig : I-4: Population of Urban Agglomeration



Sambalpur was a small township in 1901 with a population of 12870, slowly grew till 1961 (38,915) when the town had an area of 20.72 sq. km and population density of 1878 per sq. km. The urban area expanded to 46.12 sq. km with a population of 74,458 in 1971. In 1981, the population was 1,12,631 in an area of 49.75 sq. km with population density 2264 per sq. km. In 1991 the area remaining static, population rose to 1,34,824 (Municipality and its out growth) with a density of 2710 per sq.km. The decadial growth vastly slowed-down to 19.7%. This indicates the peaking of the growth of the town in 1960's and beginning to saturate thereafter. The Sambalpur Development Authority (SDA) prepared a Master Plan for the town which has been notified in 1984; covers the Municipal area, the out growth and 21 villages having an area of 95.68 sq. Km. The population in Master Plan area in 1981 was 1,32,848. Sambalpur Development Authority is responsible for planned development of the new identified urban complex (***Sambalpur-Burla-Hirakud Urban Complex***). The Municipal town of Burla and Hirakud are continuous with Sambalpur Municipal area. The total urban agglomerate of Sambalpur- Burla - Hirakud Complex has a combined population of 1,89,744 (1991).

Table: I-2: Demographic Classification as on 1991 Census

CLASSIFICATION		SAMBALPUR(M) & ITS OUTGROWTH	HIRAKUD NAC	BURLA NAC	SAMBALPUR DISTRICT
GEOGRAPHICAL AREA IN SQ.KM.		49.75	16.48	17.62	6698.0
NUMBER OF RESIDENTIAL HOUSES		25387	2565	6181	151419
NUMBER OF HOUSEHOLDS		26488	2578	6220	167770
TOTAL POPULATION	MALE	71183	12648	16898	413541
	FEMALE	63641	11185	14189	395476
	TOTAL	134824	23833	31087	809017
SCHEDULED CASTE(S.C.) POPULATION	MALE	10290	2460	3831	70026
	FEMALE	9581	2418	3660	68070
	TOTAL	19871	4878	7491	138096
SCHEDULED TRIBE(S.T.) POPULATION	MALE	7362	1767	1095	142701
	FEMALE	6945	1622	1015	141100
	TOTAL	14307	3389	2110	283801
% OF SC TO TOTAL POPUL.		14.73	20.47	24.10	17.07
% OF ST TO TOTAL POPUL.		10.61	14.22	6.79	35.08

CLIMATE

The area experiences four seasons, hot and dry Summer from march to Mid June, South-West monsoon rains from Mid June to September, October a pleasant post-monsoon from October to November and Winter from December to February. Wide fluctuation in climate during last couple of years have been experienced. Broadly speaking an unusual increase in temperature during April-May resulting sun-stroke casualties, scattered rainfalls throughout the years affecting agricultural activities and unusual cold in Winter. This has caused suffering to people. The meteorological data and climatic features described here have been collected from the IMD (Indian meteorological Department) station located at Sambalpur.

TEMPERATURE

At Sambalpur maximum of mean daily temperature has been recorded during May'98 as 48.6^0 C and the minimum of mean daily temperature recorded during February'95 as 4.2^0 C (1993-1999) (Table :I-3).The hottest period is April-June and the coldest period is December to February. The monthwise average of daily temperature during 1993-99 can be seen from Fig:I-5.

GEOLOGY

The district is constituting part of cratonic area which has been subjected to tectonic and thermal activities. Normally, cratons hosts the number of metallic as well as non-metallic minerals. The description gives an account of the mineral occurrence. Diamond(Snow white, yellowish, brown colour) has been recovered by the people of Hirakud earlier from the gravel beds and in some parts continuing till date. Presence of Gold and Gems stones have been noticed in the river bed of Mahanadi around Sambalpur. Low grade fireclay is being mined out in Chandli R.F. around Burla. Coal seams are encountered in the Gondwana rocks and have been exploited in this region. Deposit of Quartz is seen at Charbatia (Fig:I-6) .

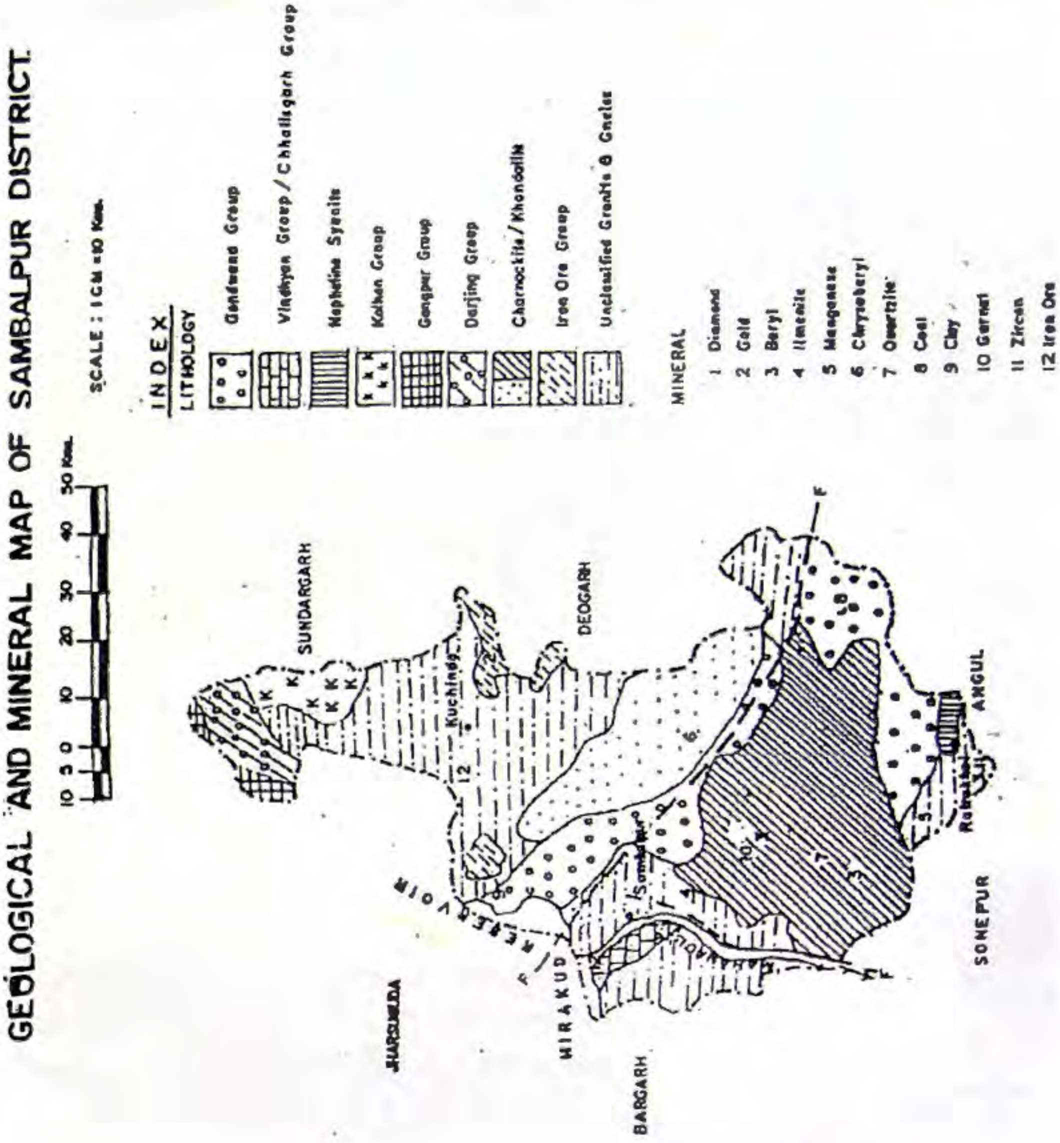


Fig: I-6 : Map on Mineral Resources

Table:I-3:Average Daily Temperature In °C

MONTH/YEAR	MEAN	MAXIMUM	MINIMUM
JANUARY(93-95)	20.4	30.8	7.0
FEBRUARY(93-95)	20.9	33.0	4.2
MARCH(93-99)	27.84	42.8	14.0
APRIL(93-99)	30.92	47.0	9.0
MAY(93-99)	34.12	48.6	16.0
JUNE(93-99)	32.45	47.6	21.0
JULY(93-95)	28.6	38.5	21.0
AUGUST(93-95)	28.0	36.2	22.0
SEPTEMBER(93-95)	27.65	35.6	20.5
OCTOBER(93-95)	27.25	35.2	19.2
NOVEMBER(93-95)	22.85	32.4	12.0
DECEMBER(93-95)	20.55	32.6	8.0

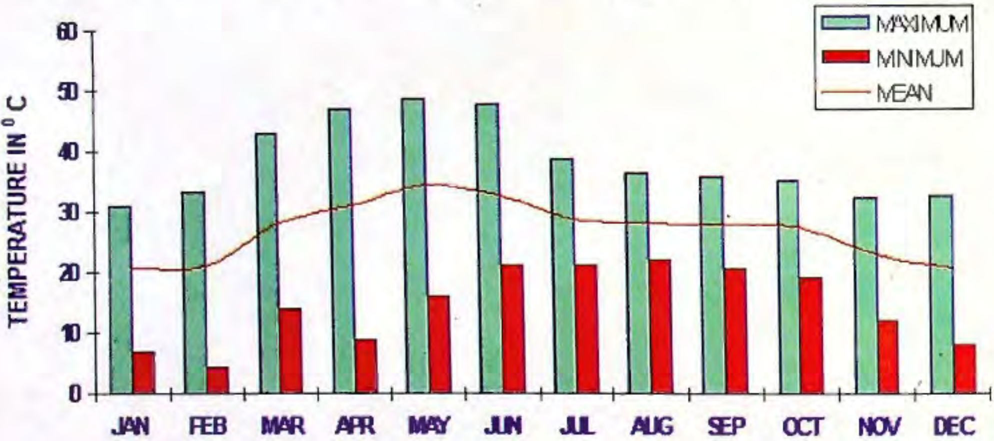


Fig: I-5: Month wise Variation of Temperature

RAINFALL

The mean (1993-1999) rainfall of Sambalpur district is 1495.78mm. The rainfall recorded in 1994 was 2057.10 mm quite higher than yearly average. The month wise rainfall pattern from 1993 to 1999 and year wise total rainfall are given in Table : I-4 & Table :I-5 respectively.

Fig: I-7: Year wise Rainfall Pattern (1993-1999)

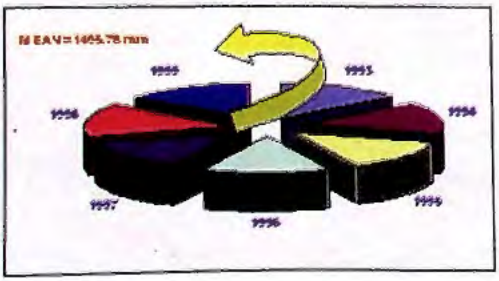


Table: I-4: Monthwise Rainfall Pattern in mm (Sambalpur Dist.) (1993-1999)

YEAR	J	F	M	A	M	J	J	A	S	O	N	D
1993	-	0.3	4.9	10.3	41.6	227.1	310.6	424.6	387.6	36.1	-	-
1994	-	0.2	-	5.4	10.4	458.9	714.9	595.0	239.5	25.9	6.9	-
1995	71.9	13.3	17.2	19.1	92.4	78.1	447.2	383.5	120.2	66.5	104.1	-
1996	-	2.66	-	1.0	1.88	308.0	282.0	315.0	115.0	13.0	-	-
1997	0.66	-	-	10.0	2.0	191.0	411.0	593.0	207.0	5.55	8.33	-
1998	-	1.55	4.77	1.77	-	148.0	255.0	206.0	277.0	560.0	28.0	-
1999	-	-	-	-	109.1	236.3	229.4	344.5	273.3	-	-	-
MEAN	23.9	4.6	7.3	11.6	48.13	254.7	490.9	467.7	249.1	42.83	37.0	-

Table: I-5: Yearwise Rainfall Pattern in mm(Sambalpur Dist.)
(1993 – 1999)

YEAR	1993	1994	1995	1996	1997	1998	1999(Sept)	MEAN
RAINFALL	1443.2	2057.1	1413.5	1039.5	1468.5	1482.09	1192.65	1495.78

RELATIVE HUMIDITY

The mean relative humidity rises to above 80 % during the monsoon months of July to September, ranging between 84-87 % in the morning (0830 IST) and 79-83 % in the evening (1730 IST). Mean relative humidity is low (48-54 %) in the Summer. The above trend in humidity in various seasons clearly shows a discernible influence of rain on humidity. The highest mean relative humidity is recorded in July-August (87 % in the morning in July and 83 % in the evening in August) and the lowest mean relative humidity is recorded in April (48 % in the morning and 27 % in the evening). High humidity during morning hours of winter, particularly in December and January (73 -75%), are contributed by the fog which is common in the area during winter. The annual average mean relative humidity is about 70 % in the morning and 53 % in the evening, which correlates well with the humid and tropical climate of the area.

WIND SPEED AND DIRECTION

The annual mean wind speed at Sambalpur is around 5.1 Km/h. Wind speed is relatively high during the Summer months of April and May (mean = 5.3 – 6.7 Km/h) and during the Monsoon months of June to September (mean=5.5 – 8.3 Km/h). During the Post- monsoon and Winter months of October to February the wind speed is relatively low (mean = 2.6 – 3.8 Km/h). The highest wind speed is about 8.3 Km/h normally observed in July.

Predominant wind directions at Sambalpur are South-West and South during Summer and Monsoon, and North-East and North during Post-monsoon and Winter. The frequencies of wind directions from South-East and South respectively are about 17.5 % and 10 % of the total time. The frequencies of wind direction from North-East and North are respectively about 11.5 % and 10.5 % of the total time. Overall calm conditions prevail over a limited time, about 26 % of the total time.

GROUND WATER POTENTIAL

The area has a granitic basement with limited ground infiltration for which the water table is high. However, the fracture, porosity zone have been successfully penetrated by 660 tube wells dug (Table :I - 6), in the town for water supply. The shallow water table is vulnerable to contamination by sewerage and toxic chemicals as well as organic pollution from solid and liquid wastes disposal on the open ground and the nallah.

Table :I – 6 : Distribution of Tube Wells

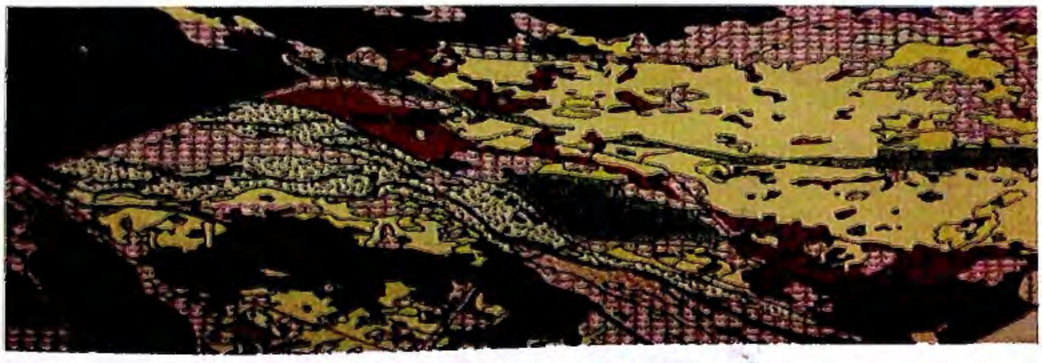
AREA	PHD	OTHERS	TOTAL
SAMBALPUR	303	68	371
BURLA	102	42	144
HIRAKUD	117	28	145

SOIL

The soil of the area is mostly characterised by red soil, but a small patch of mixed red soil and black soil appears in the Southern part of Sambalpur town. The analysis result of different top-soil (within 15 cms. depth) samples collected from different places of the study area is presented in Table : I – 7.

Table:I-7: Soil Analysis Results

Sampling Points	pH	Conductivity Mmhos/ Cm	Organic Carbon (%)	Available Phosphorous (Kg / Ha)	Available Potash (Kg / Ha)
Dhanu pali	7.5	0.3	0.663	4.48	167
Dhankauda	7.7	0.3	0.793	4.48	372
Remed	8.8	0.5	0.299	4.48	186
Khetrajpur	7.2	0.5	0.633	4.48	372
A.N.Guha lane	7.5	0.3	1.248	4.48	275
Motijharan	6.7	1.0	0.864	4.48	107
Ainthapali	7.2	0.2	0.559	4.48	372
Burla	7.2	0.2	0.702	4.48	349



SATELITE PICTURE OF STUDY AREA

SOCIO-ECONOMIC ENVIRONMENT

CHAPTER - II

EXISTING LAND USE PATTERN

Assessment of resources and inventory of land use pattern are prerequisites for scientific planning in the urban development. The land use survey reflects current problems and deficiencies, adequacy or otherwise of urban land for different social and economic functions. It will provide a broad frame-work for formulations of policies and helps for taking measures to augment land resources to meet prospective requirement in order to ensure a more balanced spatial ordering of population and economic activities in the planned urban area.

The land use pattern of Sambalpur town indicates a substantial part under agriculture. Conversion of agricultural land to habitation has been the process in last two decades. There are no major industries within the city limits. There are active road network within the town. Some commercial activities are noticed in the residential zone as well as core zone of the town. The Master Plan seeks to rationalise the land use with emphasis on green belt development. Only 11.88% of the Master Plan Area is presently developed. The typical land use pattern is placed at Table No. II – 1.

The urban area of Burla amounts to 5253.65 Acres out of the total Master Plan area of 9047.82 Acres. The existing land use pattern in the Master Plan area of Burla has broadly been devided into three categories such as built up area (1459.95 acres or 16.14%), water bodies (2284 acres or 25.24%) and agricultural land (5303.87 acres or 58.63%). The existing built up area comprising mostly residential, institutional & commercial uses are found in Burla, Kirba and to some extent Gulgunda Mouzas. Areas under water bodies include the power channel, River Mahanadi and different ponds & tanks. In the remaining areas agricultural practices still continue to exist. Table: II – 1 indicates broad land use pattern of urban area of Burla.

Existing land use pattern of Hirakud Master Plan is also placed at Table : II – 1. It shows that 593.44 acres, 4.90% of the Master Plan area are put under residential uses. Public and Semi-public user comprising office and institutional components amount to 106.00 acres out of which 16.72 acres are utilized for educational purposes. Areas utilized under Traffic, transportation & communication, Medical road, Railway and post & Telegraph amount to 321.95 acres constituting 2.66%. Areas under various Industrial & commercial uses amount to 155.52 & 14.72 acres constituting 1.28% and 0.12% of the Master Plan area respectively.

The land use pattern of the entire urban agglomeration is presented in Fig : II – 1 which depicts low development profile in the area.

EXISTING OCCUPATIONAL PATTERN

In an urban community the present economic activities & its future potentialities are generally adopted as basic guidelines for deciding spatial distribution of land. The different occupational patterns adopted in Sambalpur – Burla – Hirakud urban agglomeration are presented in Table: II – 2. & Figure: II – 2.

Table: II-1: Existing Land Use Pattern of Sambalpur - Burla - Hirakud

CLASSIFICATION		TOTAL SAMBALPUR MASTER PLAN AREA 23641.16 Ac.			TOTAL BURLA MASTER PLAN AREA 9047.82 Ac.			TOTAL HIRAKUD MASTER PLAN AREA 12107.12 Ac.		
		AREA	TOTAL AREA	%	AREA	TOTAL AREA	%	AREA	TOTAL AREA	%
DEVELOPED AREA	RESIDENTIAL USE	1024.64	20831.07 (88.12%)	36.57	639.10	1459.95 (16.13%)	43.77	593.44	1767.95 (14.61%)	33.57
	COMMERCIAL USE	194.29		6.91	20.55		1.40	14.72		0.83
	INDUSTRIAL USE	129.80		4.62	14.40		1.0	155.52		8.80
	OTHERS	1458.36		51.90	785.90		53.83	1004.27		56.80
UNDEVELOPED AREA	AGRICULTURAL	19409.89	2810.09 (11.88%)	93.17	5303.87	7587.87 (83.87%)	69.90	8244.90	10339.17 (85.39%)	79.14
	WATER BODIES	1421.18		6.83	2284.0		30.10	2094.27		20.26

Table :II-2 : Occupational Pattern Of Sambalpur - Burla – Hirakud

CLASSIFICATION			POPULATION (TOTAL POPULATION 1,89,744)				M/F	%
TOTAL WORKER	MAIN WORKER	CULTIVATORS	2,197	3.96%	55,428 (29.21%)	57,026 (30.06%)	MALE 48,121	86.82
		AGRICULTURE	3.790	6.84%				
		INDUSTRY	10,640	19.20%			FEMALE 7,307	13.18
		OTHERS	38,801	70%				
	MARGINAL WORKER				1.598 (0.85%)		MALE 319	19.96
							FEMALE 1,279	80.04
TOTAL NON WORKER						1,32,718 (69.94%)	MALE 52,289	39.4
							FEMALE 80,429	60.6

Fig : II-1 Existing Land Use Pattern

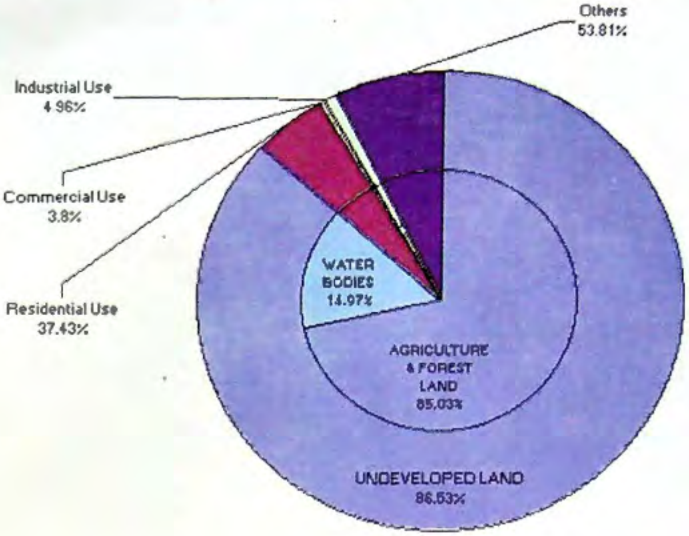
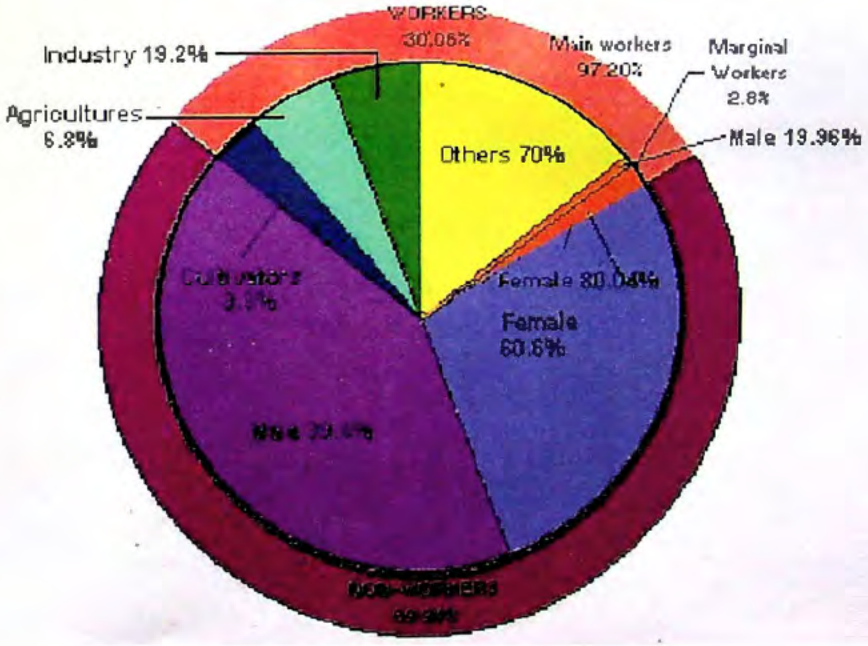


Fig : II-2 Existing Occupational Pattern



UTILITIES & SERVICES

Educational Institutions

Sambalpur- Burla - Hirakud urban agglomeration includes Sambalpur University which is the main center for education research, training & culture. Its Engineering College & Medical College at Burla are important institutions in the field of professional & technical education. In the urban agglomeration there are nine Colleges & 138 Schools (76 primary, 38 Middle Schools & 24 Secondary) of which Gangadhar Meher College is an Autonomous one. The urban literacy rate is 64.51% in comparison to the entire district with 51.56%.

Hospital Facilities:

In the urban agglomeration Burla is the center of attraction with regard to the Medical facilities available through V.S.S. Medical College Hospital which has 12 Departments with specialized doctors and has 746 Beds. In addition to this there are three Govt. Hospitals, one Maternity center and one dispensary. There are private Nursing Homes & hospitals existing which cater to medical treatment to the public.

Power Supply:

Supply of power in the urban area is done through WESCO (Taken over from GRIDCO recently). The power is being mainly supplied from the Hirakud Hydro Project & NTPC, Talcher. Sambalpur Electrical Division comprising of 5 electrical sub-divisions as given below & 116 substations distribute electricity in the district.

DIVISION	SUB-DIVISION	AREA COVERED
Sambalpur Electrical Division	Sambalpur – I & II	Sambalpur town, Sasson & Dhama
	Burla	Burla, Gasohol, Hirakud
	Rairakhol	Hatibari, Naktidewal, Rairakhol
	Ulunda	Ulunda,Birmaharajpur

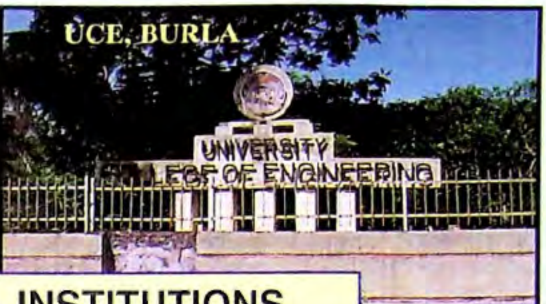
The total demand load of electricity under Sambalpur Electrical Division in June 1999 was 82.941MW. The category of consumer and their demand load for June 1999 is presented in Table: II –3 .Industries, Households & Commercial activities account for about 60%, 21% & 11% of the total power consumption respectively.

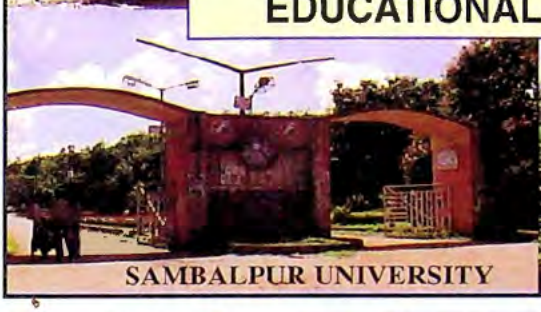
Table:II – 3 : Sambalpur Electrial Division,Sambalpur

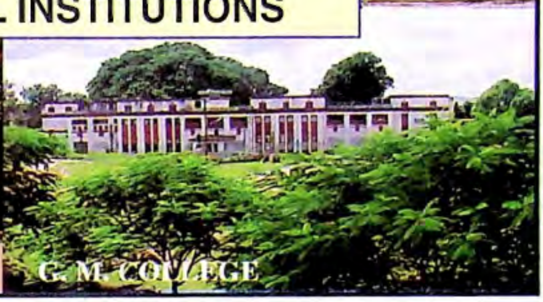
CATEGORY OF CONSUMER	NO. OF CONSUMERS	CONTACT DEMAND IN KW
Domestic	31633	17756
Commercial	5851	9560
Small Industries	380	3116
Medium Industries	54	2177
Large Industries	51	44180
O.L.I.C & Pvt. L.I (Lift Irrigation)	515	2048
Public water works(PHD)	49	1675
Public Institution	278	2185
TOTAL	**38906**	**82.941MW**

EDUCATIONAL INSTITUTIONS

MEDICAL COLLEGE, BURLA


UCE, BURLA


SAMBALPUR UNIVERSITY


G. M. COLLEGE

PUBLIC UTILITIES

NEW BUS STAND

WATER INTAKE POINTS

OH TANKS FOR WATER SUPPLY

Water Supply :

For drinking water 18.5 MLD of water is supplied in Sambalpur town after treatment. In addition there are 371 tube wells (capacity 18 litres / minutes) available around the town along with 37 dug wells. The total drinking water supply in Burla and Hirakud are 9 MLD and 4.5 MLD (surface water) respectively. Besides there are 144 and 145 numbers of tube wells in Burla and Hirakud respectively. Amount of water used from tube wells and dug wells has not been assessed.

Drainage System:

The drainage system of Sambalpur Municipality is controlled mainly by Dhobijore, Hardjore and Durgapali nallahs. The Dhobijore nallah covers a distance of about 10.16 k.ms. and collects city sewage. This nallah which has about 10 feet width and originally about 8 feet depth has been silted up by city garbage & the present depth is about 7 feet. The flow speed is 36 litres/minute an average of 129.6KL of sewage into the river. The Hardjore nallah starting from Sindurpank NH-6 passes through Dhankauda, Sunapali, Charbhati, G[illegible]dtola and then crosses NH-42. Then it passes through Commissioner's colony, Dhanupali & [illegible]hatra and joins Mahanadi. It covers a length of 6 kms having a width of 10 to 30 meter & depth of 1 to 5 meters. The eastern part of the city is drained by Dhobijore & Hardjore. Durgapali nallah having catchment area of about 22 sq.km. runs through Remed and Durgapali before falling in Mahanadi. It drains the sewage sludge of western part of the city. No treatment facility has been provided in any of the outfalls.

Burla town is not having any drainage system. The contaminated wastes & storm water drain out through power channel. The refuse of Medical College Hospital makes its way towards a pond in the Revenue Mouza of Kirba which becomes unhygienic to local people.

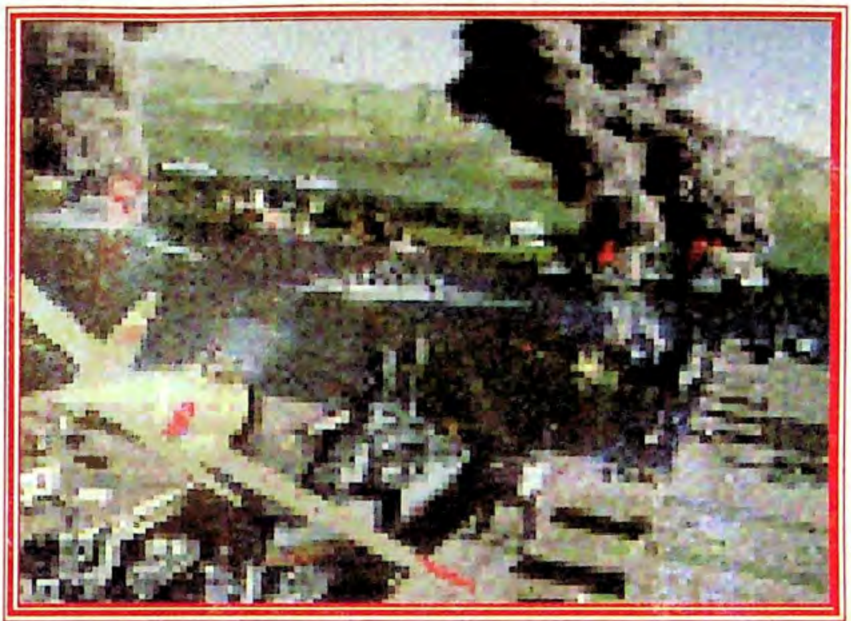
Hirakud town is served with open service drainage systems which is not adequate. The wastes & storm water are drained out through Kharjoor nallah directly into Mahanadi. Mahanadi water from Burla to down stream Sambalpur is not fit at present for drinking purpose. The Urban Local Bodies should take immediate steps to treat the sewage before discharging to the river.

Transport Systems:

In the study area of this urban agglomeration the transport network in all the places includes railways and roadways. The statistics on categories of road within Municipality area is presented in Table:II – 4. As per the data collected from Road Transport Officer (RTO), Sambalpur the total number of vehicles (two/three & four wheelers) registered up to 31.3.99 is 64328. There is a substantial increase in owner ship of vehicles since 1996 which causes Traffic congestion and increases pollution level in Ambient Air Quality. A detailed survey on traffic system and its effect on the Air Environment is discussed elsewhere in this book..

Table: II – 4 : Number of Vehicles Registered.

Sl No	**VEHICLE**	**UP TO 31/03/96**	**1996-97**	**1997-98**	**1998-99**	**UP TO 31/03/99**
1	MOTORCYCLE, SCOOTER & MOPPED	35493	3048	3709	4236	46486
2	THREE WHEELER AUTORICKSHAW	430	16	40	57	543
3	JEEP & STATIONWAGONS	2426	64	79	126	2695
4	PRIVATE CARS	1683	115	126	128	2052
5	TAXIES	202	12	14	21	249
6	CONTACT CARRIAGES	116	62	65	67	310
7	STATE CARRIAGES	830	21	2	24	877
8	TRUCKS & LORRIES	4842	439	332	240	5853
9	PETROL & WATER CARRIERS	69	10	3	4	86
10	TRACTORS & TRAILORS	3746	248	310	297	4601
11	MISC. VEHICLES	545	9	6	16	576
	TOTAL	**50382**	**4044**	**4686**	**5216**	**64328**



AIR ENVIRONMENT

CHAPTER - III

AMBIENT AIR QUALITY

The increasing air pollution level in urban areas are causing a grave concern. Further efforts are needed to formulate appropriate control and management strategy to deal with this problem. Rapidly growing cities/towns, more traffic load, reliance on outdated industrial process, growing energy consumption, lack of appropriate industrial zoning and environmental regulations, poor implementation of control measures etc. have also contributed to reduced air quality. Air pollution arising out of ever increasing number of vehicles, locations of different kinds of industries and varied social activities of the people have rendered the atmosphere of cities/towns extremely vulnerable. Motor vehicles cause more pollution than any other single human activities. The variety of matter emitted into the atmosphere by natural and anthropogenic sources is so diverse that it is very difficult to classify air pollutants . However ,usually they are divided into two categories, namely primary pollutants and secondary pollutants . The primary pollutants are emitted directly from the sources which include particulates, inorganic gases such as Sulfur dioxide, Hydrogen sulfide , Nitric oxide ,Ammonia, Carbon dioxide, Hydrogen fluorides ,Olefinic ,Aromatic-hydrocarbons and Radioactive compounds. The secondary pollutants are formed in the atmosphere by chemical interactions among primary pollutants and normal atmospheric constituents. Pollutants such as Sulphur trioxide, Nitrogen dioxide ,PAN (Peroxyacetyl nitrate), Ozone, Aldehydes, Ketones and various Sulphate and Nitrate salts are included in this category . Of the large number of primary pollutants emitted into the atmosphere,only a few are present in sufficient concentrations to be of immediate concern .These are Particulates, Sulfur dioxide, oxides of Nitrogen, Carbon monoxide and Hydrocarbons .Though the anthropogenic (man-made) pollution is negligible in early centuries , it has reached a comparable quantum in recent years.

A study was made for assessment of ambient air quality parameters in this urban agglomeration through direct monitoring randomly at eleven selective monitoring points based on available information on meteorology and sources of pollution. A fixed monitoring station has been in operation to assess the air quality of Sambalpur town at Modi para since December 1997 (Plate).

CHARACTERESTICS OF MONITORING STATIONS

Description on the location of the monitoring stations (Plate) and activities of the areas are given in Table:III-1.

Table:III-1 : Monitoring Stations

NAME OF LOCATIONS	DESCRIPTION ON MONITORING STATIONS & NATURE OF ACTIVITIES
MUNICIPALITY OFFICE AREA (DALEIPARA)	It is a residential & commercial area. Most of the Govt.Office buildings are situated within 1 km. radius of this location.
HIRAKUD COLONY AREA	It is also a residential & commercial area.
SAKHIPARA AREA	There are many hotels, restaurants & commercial establishments situated in this region. Besides it is thickly populated residential area.
MARWARIPARA AREA	Golebazar is nearer to this area which is an important business area of Sambalpur and is the nerve center of retail trade. Many important trading & commercial establishments are located here. The most important of the Bazaar is its daily market on which many households of Sambalpur depend for their bare necessities i.e vegetables & non-vegetable items.

NAME OF LOCATION	DESCRIPTION ON MONITORING STATIONS & NATURE OF ACTIVITIES
DHANUPALI	It is purely a residential area.
BALIBANDHA	Balibandha is full of residential houses & temples , monuments are located within the area.
AINTHAPALI AREA	Ainthapali area is one of the most busiest area due to the multifarious activities of commercial complexes , fabrication & engineering units and connection of NH-6 and SH-10 along with residential houses. The Sambalpur main Bus Stand has shifted from the town to this locality since last year.
KHETRAJPUR	It is one of the most crowded area of the town due to its commercial and industrial activities. It is situated near Railway station. It is becoming more populated due to the establishment of railway colonies few years back.
REMED AREA	It is at the outskirts of the Sambalpur town & the connecting place between Sambalpur, Burla and industrial town of Hirakud. N.H.-6 crosses through the locality. It is one of the busiest area with industrial and commercial activities.
NEAR NAC OFFICE (BURLA TOWN)	Burla is the satelite town of Sambalpur at a distance of about 16 K.M. from Sambalpur. Burla is considered to be most important area with respect to higher education. Sambalpur University & two other large professional institutions i.e. U. C .E and V.S.S Medical Collage & hospital are located. Burla is surrounded by the River Mahanadi on in the east, Hirakud Dam on the west & hills / reserve forests on the north & south.
HIRAKUD	Hirakud is an important industrial town having two large & three medium industries. It is quite famous due to the presence of longest earthen Dam of the World on River Mahanadi. Apart from that other activities of tiny industries are also in existence along with residential & commercial activities.
MODIPARA AREA (FIXED STATION)	**It is a residential as well as busy area. The point of monitoring is carried on the roof of the filter plant of Public Health Department.**

MONITORING SCHEDULE

In the Fixed Monitoring Station three sets of 8 hourly average samples are collected for 24 hours twice in a week and for other locations 8 hourly samples have been collected randomly. The sampling and analytical procedure followed during this AAQ Monitoring is based on the methods laid down in the Standard Method.

Table:III-2: Average Ambient Air Quality Results

Sl no	Area	MONSOON				POST MONSOON				WINTER				SUMMER			
		RPM	SPM	SO2	Nox	RPM	SPM	SO2	Nox	RPM	SPM	SO2	Nox	RPM	SPM	SO2	NOx
1	M.Office Area (Daleipara)	62.3	154.0	6.4	14.0	72.3	136.0	10.1	12.3	76.4	184	18.6	31.7	92.9	167.0	20.2	24.4
2	Hirakud Colony	49.0	139.5	7.4	14.6	81.4	162.0	9.3	18.7	85.0	152.0	24.0	16.0	68.3	191.2	14.0	20.0
3	Sakhipara	71.9	123.7	13.4	55.2	96.0	202.0	26.0	39.2	118.3	214.2	12.3	31.4	124.4	257.2	10.9	33.7
4	Marwaripara	91.5	242.2	17.6	22.5	112.0	302.0	22.0	40.1	169.1	319.8	63.0	28.3	188.0	384.0	30.1	83.0
5	Dhanupali	64.8	179.4	9.8	40.2	66.0	180.0	10.3	26.3	97.0	194.0	19.6	32.0	118.2	177.3	21.3	36.2
6	Balibandha	57.1	160.0	6.01	10.1	50.0	101.0	9.2	22.7	66.0	107.0	9.6	10.4	72.0	151.8	10.3	14.4
7	Ainthapali	46.2	133.1	7.3	8.4	91.4	255.8	47.0	81.0	104.9	212.0	14.2	39.1	104.1	206.2	14.2	40.2
8	Khetrajpur	93.9	277.0	23.8	29.2	73.8	292.0	20.2	36.4	83.4	302.0	19.1	50.4	110.4	344.0	21.9	62.4
9	Remed	136.9	445.4	44.2	88.5	192.0	466.0	81.4	90.0	189.5	514.0	21.4	72.8	207.0	641.2	30.4	87.4
10	Burla N.A.C.	58.1	155.1	9.1	14.3	62.0	132.0	16.4	20.2	66.9	139.4	14.0	22.0	82.5	159.7	10.7	30.2
11	Hirakud	77.4	161.8	17.6	20.4	81.0	144.0	36.0	24.0	99.7	158.0	28.0	21.4	93.0	182.0	24.2	41.6

All the figures presented in the above table are expressed in $\mu g/m^3$.

a. Suspended Particulate Matter (SPM)

Particulate matter which remains under suspension in the air are a composite group of substances solid or liquid dispersed in atmosphere. The most significant fraction of SPM is the respirable size, that is longer than about 0.1 micron & smaller than about 5.0 micron. Particles of these range persist in the atmosphere longer than other sizes. This range is significant not only in respect of health, but also in causing reduced visibility & entering into atmospheric reactions. Air pollutants enter the human body through two avenues; (1) Inhalation & (2) Absorption. Inhalation is the most common route of intake of air borne contaminates into lungs & into the blood stream. Many gases & liquids are absorbed to a limited extent through the skin.

The results for seasonal average SPM concentration at the eleven monitoring stations are given in Table:III-2. During Monsoon average SPM concentration was found to be lowest of 123.7 µg/m³ (Sakhipara) to the highest of 445.4 µg/m³ (Remed area).But in Post-monsoon this varied from a maximum of 466.0 µg/m³ (Remed Area) to minimum of 101.0 µg/m³ (Balibandha).The maximum value of SPM at Remed area again has been recorded to be 514.0 µg/m³ & minimum value recorded at Balibandha 107.0 µg/m³ during Winter. During Summer values were found to be 641.2 µg/m³ (Remed Area) to 151.8 µg/m³ (Balibandha). The results from the observation suggest that the average SPM concentrations are usually on higher side during Summer & on lower side during the Monsoon in all the monitoring stations.

Depending upon the relative activities of different area; they are classified as three categories

- Industrial & Mixed use Areas
- Residential , Rural & other Areas
- Sensitive Area

As per the classification Remed, Khetrajpur, Hirakud areas are being accepted as Industrial areas and the rest are considered as residential areas except Burla which in the present context has been considered as sensitive area. Further it is observed that higher concentrations of SPM were found in Remed area in Winter and Summer with respect to Industrial area standard & at Sakhipara and Ainthapali in Post-monsoon, Winter & Summer and at Marwaripara throughout the year exceeding the limit for Residential area Standard provided in National Ambient Air Quality Standard (Table:III-3). There has been no remarkable problem of SPM observed at 7 other monitoring stations. The causes of deterioration of air quality at Remed area is being discussed in length.

b. Respirable Particulate Matter (RPM)

The seasonal average RPM concentration (Table-III-2) was lowest in Monsoon where they varied between a lowest of 49.0 µg/m³ (Hirakud Colony) to the highest of 136.9 µg/m³ (Remed area). RPM concentrations was found to be 50.0 µg/m³ (Balibandha) to 192.0 µg/m³ (Remed Area) during Post-monsoon. During this season the RPM concentrations was observed more or less similar trend to that of the Monsoon. The seasonal average RPM concentrations during Winter ranged between 66.0 µg/m³ (Balibandha) to 189.5 µg/m³ (Remed area). During Summer season most of the stations had considerably higher values than other seasons. It could be due to dry weather & wind conditions which results in lifting up the loose plains fine slit. The annual averages at stations located close to

NAME OF LOCATION	DESCRIPTION ON MONITORING STATIONS & NATURE OF ACTIVITIES
DHANUPALI	It is purely a residential area.
BALIBANDHA	Balibandha is full of residential houses & temples , monuments are located within the area.
AINTHAPALI AREA	Ainthapali area is one of the most busiest area due to the multifarious activities of commercial complexes , fabrication & engineering units and connection of NH-6 and SH-10 along with residential houses. The Sambalpur main Bus Stand has shifted from the town to this locality since last year.
KHETRAJPUR	It is one of the most crowded area of the town due to its commercial and industrial activities. It is situated near Railway station. It is becoming more populated due to the establishment of railway colonies few years back.
REMED AREA	It is at the outskirts of the Sambalpur town & the connecting place between Sambalpur, Burla and industrial town of Hirakud. N.H.-6 crosses through the locality. It is one of the busiest area with industrial and commercial activities.
NEAR NAC OFFICE (BURLA TOWN)	Burla is the satelite town of Sambalpur at a distance of about 16 K.M. from Sambalpur. Burla is considered to be most important area with respect to higher education. Sambalpur University & two other large professional institutions i.e. U. C .E and V.S.S Medical Collage & hospital are located. Burla is surrounded by the River Mahanadi on in the east, Hirakud Dam on the west & hills / reserve forests on the north & south.
HIRAKUD	Hirakud is an important industrial town having two large & three medium industries. It is quite famous due to the presence of longest earthen Dam of the World on River Mahanadi. Apart from that other activities of tiny industries are also in existence along with residential & commercial activities.
MODIPARA AREA (FIXED STATION)	**It is a residential as well as busy area. The point of monitoring is carried on the roof of the filter plant of Public Health Department.**

MONITORING SCHEDULE

In the Fixed Monitoring Station three sets of 8 hourly average samples are collected for 24 hours twice in a week and for other locations 8 hourly samples have been collected randomly. The sampling and analytical procedure followed during this AAQ Monitoring is based on the methods laid down in the Standard Method.

Table:III-2: Average Ambient Air Quality Results

Sl no	Area	MONSOON				POST MONSOON				WINTER				SUMMER			
		RPM	SPM	SO2	Nox	RPM	SPM	SO2	Nox	RPM	SPM	SO2	Nox	RPM	SPM	SO2	NOx
1	M.Office Area (Daleipara)	62.3	154.0	6.4	14.0	72.3	136.0	10.1	12.3	76.4	184	18.6	31.7	92.9	167.0	20.2	24.4
2	Hirakud Colony	49.0	139.5	7.4	14.6	81.4	162.0	9.3	18.7	85.0	152.0	26.0	16.0	68.3	191.2	14.0	20.0
3	Sakhipara	71.9	123.7	13.4	55.2	96.0	202.0	26.0	39.2	118.3	214.2	12.5	31.4	124.4	237.2	10.9	33.7
4	Marwaripara	91.5	243.2	17.6	22.5	112.0	302.0	22.0	40.1	169.1	319.0	63.0	28.3	188.0	384.0	30.1	83.0
5	Dhanupali	54.8	179.4	9.8	40.2	66.0	180.0	10.3	26.3	97.0	194.0	19.6	32.0	118.2	177.3	21.3	36.2
6	Balibandha	57.1	160.0	6.01	10.1	50.0	101.0	9.2	22.7	66.0	107.0	9.6	10.4	72.0	151.8	10.3	14.4
7	Ainthapali	46.2	133.1	7.3	8.4	91.4	255.8	47.0	81.0	104.9	212.0	14.2	39.1	104.1	206.2	14.2	40.2
8	Khetrajpur	93.9	277.0	23.8	29.2	73.8	292.0	20.2	36.4	83.4	302.0	19.1	50.4	110.4	344.0	21.9	62.4
9	Remed	136.9	445.4	44.2	88.5	192.0	464.0	81.4	90.0	189.5	514.0	21.4	72.8	207.0	641.2	30.4	87.4
10	Burla N.A.C.	58.1	155.1	9.1	14.3	62.0	132.0	16.4	20.2	66.3	139.4	14.0	22.0	82.5	159.7	10.7	30.2
11	Hirakud	77.4	161.8	17.6	20.4	61.0	144.0	34.0	24.0	99.7	158.0	28.0	21.4	93.0	182.0	24.2	41.6

All the figures presented in the above table are expressed in µg/m³.

a. Suspended Particulate Matter (SPM)

Particulate matter which remains under suspension in the air are a composite group of substances solid or liquid dispersed in atmosphere. The most significant fraction of SPM is the respirable size, that is longer than about 0.1 micron & smaller than about 5.0 micron. Particles of these range persist in the atmosphere longer than other sizes. This range is significant not only in respect of health, but also in causing reduced visibility & entering into atmospheric reactions. Air pollutants enter the human body through two avenues; (1) Inhalation & (2) Absorption. Inhalation is the most common route of intake of air borne contaminates into lungs & into the blood stream. Many gases & liquids are absorbed to a limited extent through the skin.

The results for seasonal average SPM concentration at the eleven monitoring stations are given in Table:III-2. During Monsoon average SPM concentration was found to be lowest of 123.7 μg/m³ (Sakhipara) to the highest of 445.4 μg/m³ (Remed area).But in Post-monsoon this varied from a maximum of 466.0 μg/m³ (Remed Area) to minimum of 101.0 μg/m³ (Balibandha).The maximum value of SPM at Remed area again has been recorded to be 514.0 μg/m³ & minimum value recorded at Balibandha 107.0 μg/m³ during Winter. During Summer values were found to be 641.2 μg/m³ (Remed Area) to 151.8 μg/m³ (Balibandha). The results from the observation suggest that the average SPM concentrations are usually on higher side during Summer & on lower side during the Monsoon in all the monitoring stations.

Depending upon the relative activities of different area; they are classified as three categories

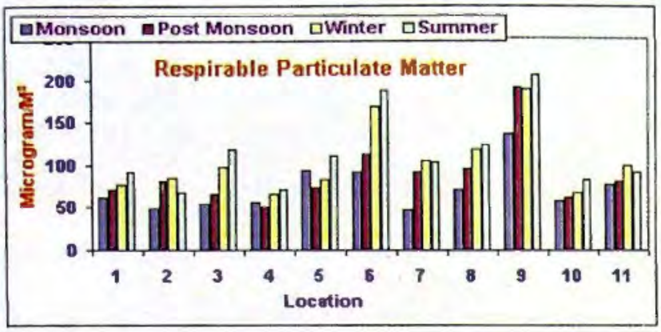
- Industrial & Mixed use Areas
- Residential , Rural & other Areas
- Sensitive Area

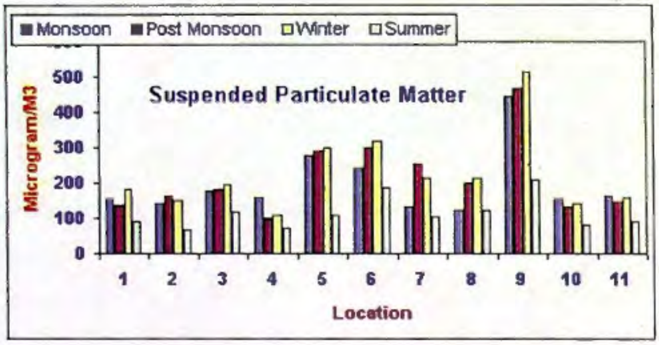
As per the classification Remed, Khetrajpur, Hirakud areas are being accepted as Industrial areas and the rest are considered as residential areas except Burla which in the present context has been considered as sensitive area. Further it is observed that higher concentrations of SPM were found in Remed area in Winter and Summer with respect to Industrial area standard & at Sakhipara and Ainthapali in Post-monsoon, Winter & Summer and at Marwaripara throughout the year exceeding the limit for Residential area Standard provided in National Ambient Air Quality Standard (Table:III-3). There has been no remarkable problem of SPM observed at 7 other monitoring stations. The causes of deterioration of air quality at Remed area is being discussed in length.

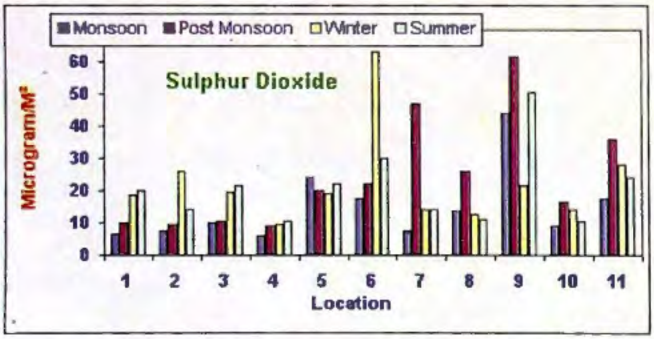
b. Respirable Particulate Matter (RPM)

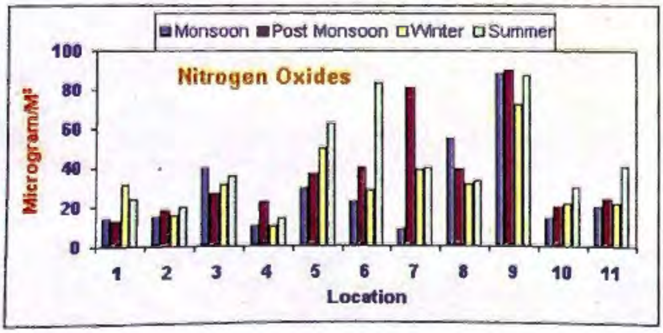
The seasonal average RPM concentration (Table-III-2) was lowest in Monsoon where they varied between a lowest of 49.0 μg/m³ (Hirakud Colony) to the highest of 136.9 μg/m³ (Remed area). RPM concentrations was found to be 50.0 μg/m³ (Balibandha) to 192.0 μg/m³ (Remed Area) during Post-monsoon. During this season the RPM concentrations was observed more or less similar trend to that of the Monsoon. The seasonal average RPM concentrations during Winter ranged between 66.0 μg/m³ (Balibandha) to 189.5 μg/m³ (Remed area). During Summer season most of the stations had considerably higher values than other seasons. It could be due to dry weather & wind conditions which results in lifting up the loose plains fine slit. The annual averages at stations located close to

FIG : III - I : AMBIENT AIR QUALITY MONITORING RESULTS









LOCATIONS :

1 : Municiplity Office Area
2 : Hirakud Colony
3 : Sakhipara
4 : Maruawaripara
5 : Dhanupali
6 : Balibandha
7 : Ainthapali
8 : Khetarajpur
9 : Remed
10: Burla NAC
11: Hirakud NAC.

AAQ Monitoring Station
at Municipality Office

SAAQM Station at Modipara

AAQ Monitoring Station at Dhanupali

AAQ Monitoring Station at Remed

Noise Monitoring at Remed

industrial/commercial activities i.e. Remed Area, Marwaripara, Ainthapali Area, Khetrajpur Area had relatively higher values as compared to National Ambient Air Quality Standard (NAAQS).These monitoring stations are influenced by pollution through multi-sources i.e. urban development, vehicular traffic, industrial and commercial activities.

c. Sulphur Dioxide

The seasonal average of sulphur dioxide concentrations in the entire study area never exceeded NAAQS for industrial/mixed use & residential/rural areas. The concentrations of SO_2 varied 6.01 µg/m^3 (Balibandha) to 44.2 µg/m^3 (Remed area), 9.2 µg/m^3 (Balibandha) to 81.4 µg/m^3 (Remed area), 9.6 µg/m^3 (Balibandha) to 63.0 µg/m^3 (Marwaripara) & 10.7 µg/m^3 (Burla Town) to 30.4 µg/m^3 (Remed area) during Monsoon, Post-monsoon, Winter & Summer respectively.

d. Nitrogen Oxide

The highest concentration of NOx (seasonal average) was observed at 88.5 µg/m^3 (Remed area) during Monsoon. But it varied from 12.3 µg/m^3 (Municipality Office Area, Daleipara) to 90.0 µg/m^3 (Remed area) in Post-monsoon. The range of NOx remained within 10.4 µg/m^3 (Balibandha) to 72.8 µg/m^3 (Remed area) in Winter and 14.4 µg/m^3 (Balibandha) to 87.4 µg/m^3 (Remed area) during Summer respectively. The average NOx values exceeded the National Ambient Air Quality standard in Post-monsoon at Ainthapali and in Summer at Marwaripara might be due to heavy traffic load in these localities.

Table:III-3: National Ambient Air Quality Standard

Pollutant	Time weighed average	Con. in ambient air		
		Industrial Area	Residential Rural & Other	Sensitive Area
Suspended Particulate Matter	Annual Avg.	360µg/m^3	140µg/m^3	70µg/m^3
	24 Hours	500µg/m^3	200µg/m^3	100µg/m^3
Respirable Particulate Matter	Annual Avg.	120µg/m^3	60µg/m^3	50µg/m^3
	24 Hours	150µg/m^3	100µg/m^3	75µg/m^3
Sulphur Dioxide	Annual Avg.	80µg/m^3	60µg/m^3	15µg/m^3
	24 Hours	120µg/m^3	80µg/m^3	30µg/m^3
Oxides of Nitrogen	Annual Avg.	80µg/m^3	60µg/m^3	15µg/m^3
	24 Hours	120µg/m^3	80µg/m^3	30µg/m^3

SAAQM STATION (FIXED POINT)

The maximum value of SPM at Roof of Filter Plant, Modipara was observed 402 µg/m^3 during the month of March'99 & minimum during January'99 (105.0 µg/m^3). The monthly average values of concentration of SPM and RPM are given in Table:III-4. The average monthly values for SPM except for the months March, April, December generally remained within the limit prescribed for residential areas (140 µg/m^3). However, the monthly variations of RPM concentrations are found within standard (60µg/m³) except for the months of February, March, April, May & December (Fig:III- 2).

Table:III-4: Average SPM Concentration at Modipara.

MONTH	RPM IN µg/m³	SPM IN µg/m³
January	51.2-L	112.95-L
February	**101.25-H**	132.265-L
March	**95.6-H**	**194.7-H**
April	**107.3-H**	**196.61-H**
May	**89.44-H**	130.30-L
June	52.63-L	78.77-L
July	54.83-L	80.26-L
August	53.23-L	79.45-L
September	48.2-L	74.4-L
October	45.3-L	67.8-L
November	49.4-L	79.14-L
December	**88.4-H**	**143.05-H**

H : High **L** : Low

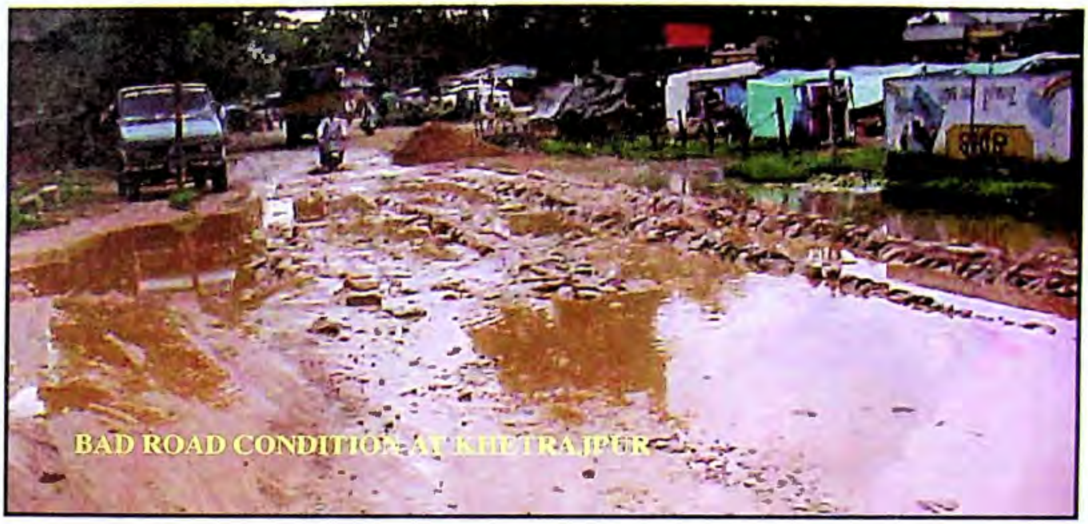
It is seen from the Table:III-5 that the RPM concentration at Summer and Winter were observed high and the SPM concentration on the other hand were found well within the norm except in Summer (Fig:III-3).

CRITICAL AREA

It has been observed during the study that Remed area and its surrounding is mostly polluted due to many-fold reasons. The Remed chowk is the crossing point for Sambalpur – Burla road (NH-6) and Sambalpur – Hirakud road . The plying of vehicles mainly HTV has been recorded maximum in this point. Besides, this area is surrounded by heavy industrial activities and roaring commercial functionings.

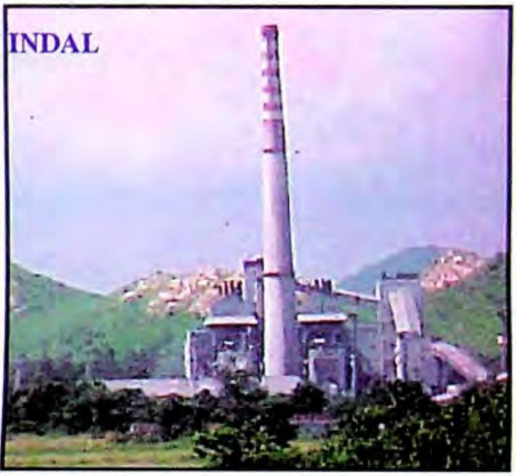
Seven numbers of rice mills, four stone crushers, one coke manufacturing unit, eleven number of service garages are the important industrial activities in that area which are located within one kilometer radius. Due to this, the area has been earmarked as one of the critical area of the town with regard to pollution is concerned. Though most of the rice mill adopted water treatment systems ;yet they need improvement in utilisation of treated water. The problem of solid waste by the rice mill is acute as they dump the waste here and there in the nearby areas causing dust pollution mostly. The emission from the boiler stack seems not beyond the limit as some of them have dust collecting systems in their respecting units. While discussing about stone crushers namely (1) M/S K.B. Industries, (2) M/S Krishna Metal Works, (3) M/S Bijay Metal Works and (4) M/S Ashok Stone Crushers; they were already marked due to their illegal siting and causing dust pollution. Directions were given already by the Board as well as from the Administration for shifting of those units to suitable locations.

As all the activities are combindly operating in that area , it is obvious for de-gradation of environmental factors like water quality, ambient air quality, ambient noise level etc. These subjects are dealt in detail in other chapters.



BAD ROAD CONDITION AT KHETRAJPUR

POWER & SMELTER PLANT INDAL



STONE CRUSHERS AT REMED AREA

Fig : III - 2 : Monthly Variation of SPM & RPM at SAAQM Station, Modipara

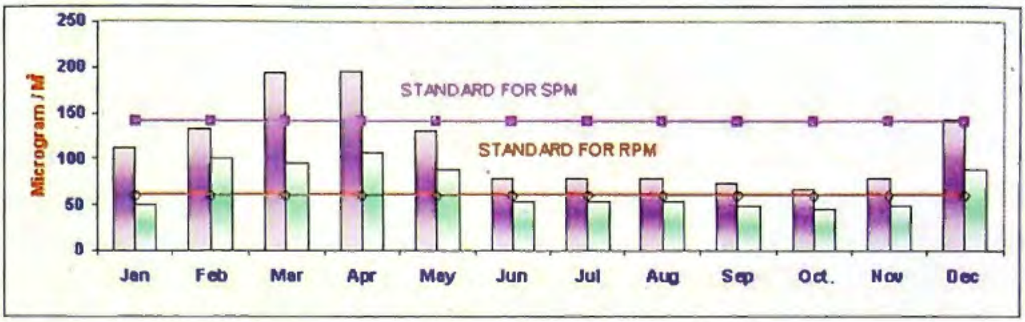
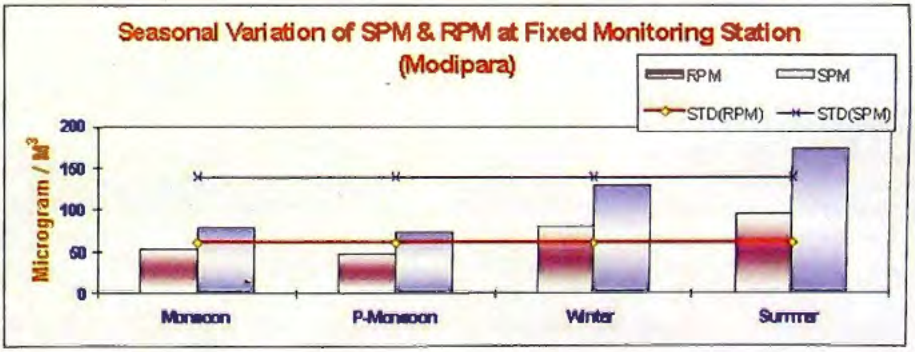


Table:III-5 : Seasonal Variation of RPM & SPM at Fixed Station at Modipara

Parameters	Monsoon	Post Monsoon	Winter	Summer
RPM	53.3	47.6	80.2	95.4
SPM	79.4	74.2	129.4	173.8

Fig :III- 3 : Seasonal Variation



EVALUATION OF AIR QUALITY INDEX (AQI)

In order to asses the air quality status, the air quality index (AQI) of the study area is evaluated based on equal importance to all the pollutant parameters as observed. Air quality rating for all the pollutants parameters were initially calculated by the following expressions:

$$Qi = (Vi \times 100)/Vs$$

Where as **Vi** = Observed value of the parameter
Vs = Standard value recommended for the parameter

The AQI is evaluated by the geometric means of their air quality ratings. The AQI is than compared in Table:III-6 in order to assess the air quality status of Sambalpur-Burla Hirakud Complex.

Table:III-6: Air Quality Index

CATAGORY	AQI	DESCRIPTION
I	< 10	Very clear
II	10 – 25	Clear
III	25 – 50	Fairly clear
IV	50 –75	Moderately polluted
V	75 – 100	Polluted
VI	100 – 125	Heavily polluted
VII	>125	Severely polluted

The AQI of the study area is found to be 35.12 (fairly clear) during Monsoon, 48.90 (moderately polluted) in Post monsoon, 51.66 (moderately polluted) in Winter and 54.74 (moderately polluted) in Summer. The geometric mean of all AQI values ultimately reflected a over all AQI of 46.79 which indicates that the study area is found fairly clear.

AMBIENT NOISE LEVEL

Noise, one of the environment pollutants encountered in day to day life. Continued exposure to high levels of noise results in annoyance, fatigue and temporary shift of hearing which may lead to permanent loss of hearing. The evasiveness of sound depends on the pitch, intermittence, information content and also the mood of the receiver at that moment. A complete objective quality value is therefore difficult to measure. For all practical purposes sound pressure level of the area/location is being measured. In order to know the Ambient noise level; continuous monitoring of noise was performed i.e. from 8.00am to 8.00pm at different areas such as Residential, Industrial, Commercial and in areas prevailed silence and sensitiveness (Table:III-8).

Sound Level Distribution : At any place the sound level is always constant. It varies from moment to moment. The weighted average sound level over the time of measurement is expressed as Leq. Sound level distribution at any place over the time of measurement may also be expressed in Percentile Exceeding Level.Some examples are:

MAXP = L_{max}: Maximum RMS Level which represents the sound level exceedining 1% of the total monitoring time.

MAXL = L_{10} :Maximum RMS Level which represents the sound level exceedining 10% of the total monitoring time.

MINL = L_{90} : Maximum RMS Level which represents the sound level exceeding 90% of the total monitoring time.

Table:III-7:Ambient Noise Standards as notified under EP ACT,1986.

Area code	Category of Area	Limits in dB(A) Leq	
		Day Time	Night Time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Table:III-8:Ambient Noise Level of different areas

POINT OF MONITORNG	MUNICIPALITY OFFICE AREA	HIRAKUD COLONY	SAKHIPARA	MARWARIPARA	DHANUPALI	BALIBANDHA	AINTHAPALI	KHETRAJPUR	REMRD	BURLA	HIRAKUD
CATEGORY OF AREAS	**R**	**R**	**C**	**C**	**R**	**S**	**C**	**I**	**I**	**S**	**I**
NOISE LEVEL Leq dB(A)	55	52	61	67	52	47	65	79	76	53	51

R : Residential Area, **C** : Commercial Area, **I** : Industrial Area, **S** : Silence Zone

The Leq values obtained at Marwardipara [67.0 dB(A)], Khetrajpur [79 dB(A)] and Remed area [76.0 dB(A)], are just above the respective prescribed standard. The noise level at Marwaripara was observed above the standard as it is a congested area with regard to narrow road, closely constructed houses with limited open space around. However, Remed and Khetrajpur areas are associated with full of activities like industrial, commercial along with closely knitted houses. The road condition are also badly affected as a result of which there has been regular traffic congestion in roads. As National Highway-6 is passing through the Remed Area; maximum number of vehicles have been plying throughout the day. Inflow of local and outside people to Khetrajpur area has been increasing day by day due to Sambalpur Railway station and the Railway colonies.

The overall ambient noise level in all areas are well within the norm (fig. III-5) except in Burla (slightly higher the norm). But adequate care may be taken to restrict establishment of shops and commercial activities within pure residential areas.

Table: III-9 : Average Noise Level In Different Area.

CATEGORY OF AREAS	AVERAGE NOISE LEVEL DAY TIME Leq dB(A)
Residential Area	53.00.<.55.00
Commercial Area	64.00 < 65.00
Industrial Area	72.00 < 75.00
Silence Zone	53.00 > 50.00

VEHICULAR POLLUTION

Automobiles have come to mankind as a mixed blessing while they enable mankind to conquer distances and serve as a quick means of transport. They have also caused flagrant damage to the human environment, polluted the atmosphere and made human beings vulnerable to several diseases. The most affected group of people are the urban inhabitants, the city dwellers, drivers, venders, shopkeepers and residents in the busy city area each of whom inhale large volume of toxic pollutants everyday.

Pollutants Emitted By Automobiles

Automobiles use internal combustion engine comprising two types

- Spark ignition using petrol or gasoline.
- Compression ignition using diesel engine.

Unburnt fuel along with intermediates and final products of combustion find their way through automobile exhaust. The intermediate products include varieties of Hydrocarbon, Aldehydes , Ketones etc. Carbon Monoxide (CO), Carbon dioxide (CO), Various oxides of Nitrogen (NOx) produced by oxidation of nitrogen of air under high temperature and pressure prevalent in the engine and nitrated organic compounds formed through the interaction of the organic compounds with NOx are some of the final products of combustion.

The pollutants emitted from automobiles may vary diverse in nature in terms of their chemical structure and chemical formula.

Table:III-10: Predominant Sources of Combustion of Engines

POLLUTANTS	SOURCE (PREDOMINANTLY)
Hydrocarbons	Petrol engines
Carbon monoxides	Petrol engines
Particulate.	Diesel and Two stroke engines
Oxides of Nitrogen	Diesel engine

Table:III-11 :Range of CO,HC,Smoke Intensity in Vehicles

Types		No.Examined	CO (%)	Standard For CO(%)	HC (ppm)	Smoke Intensity (SI) (HSU)	Standard For SI (HSU)
Petrol Driven	Four Wheeler	8	1.7 – 2.8	3.0	210 – 700	-	-
	Two Wheeler	10	1.2 – 3.2	4.5	2190 – 5800	-	-
Diesel Driven		14	-	-	-	42 - 62	65

TRAFFIC CENSUS

The intensity of traffic in an area varies during the day and between the days. In addition each of the vehicle may stay for different length of time within the area. The impact of vehicular pollutants on ambient air quality is substantially influenced by meteorological conditions.

The vehicles moving on the road are being categorized as :

Heavy Tonnage Vehicle (HTV): These are defined as transport vehicles with gross vehicle weight more than 4536 Kg and include buses, heavy trucks, dampers etc.
Medium Tonnage Vehicle (MTV) : These are defined as transport vehicles with gross vehicle weight less than 4536 Kg. and include Matadors, Cars, Jeeps etc.
Light Tonnage Vehicle (LTV) : These are include only two wheeler and three wheeler i.e. Scooters and Motor cycles.

Sambalpur is one of the main towns in western Orissa. All the Govt. Offices as well as other commercial centres are located in this region. The N.H.-42 and N.H.-6 are passing through the town. S.H.-10 is also connected to the town with Jharsuguda. The total number of vehicles registered in Sambalpur RTO is 64328 up to March'99. A detailed survey was conducted to evaluate the traffic flow (incoming & outgoing) at all the six entry points of the town from 08.00hr to 20.00hr during the day. The number of Heavy Vehicles(HTV), Medium Vehicles(MTV) and Light Vehicles(LTV) have been numbered. Variation of flow in different hour were also noted which are reflected in Table:III-12. It was observed that Remed Chowk Gate recorded highest number of vehicles i.e. 3396 during the period of observation and out of which 952, 1126, 1318 numbers were HTV, MTV, LTV respectively. It was observed that from 09.00hr to 10.00hr and 17.00hr to 18.00hr the traffic intensities were high due to heavy plying of vehicles. In all the observation points light tonnage vehicles (LTV) remained the predominant mode of transport followed by MTV and HTV. It was observed that from 1 P.M. to 2 P.M. the traffic intensity was less i.e. in lean hours.

Table:III-12: Traffic Census at Entry points

TIME	REMED CG (SBP-BGH - NH-6)				HIRAKUD CG (SBP-HKD RD)				AINTHAPALI CG (SBP-JSG- SH-10)				SINDURPANK CG (SBP-DGH-NH-6)				KHALIABANDH CG(SBP-CTC-NH-42)				BHATRA CG (SBP-DHAMA RD)				TOTAL
	H	M	L	T	H	M	L	T	H	M	L	T	H	M	L	T	H	M	L	T	H	M	L	T	
08-09	103	75	97	275	16	17	65	98	45	72	161	278	24	20	25	69	38	42	137	217	5	20	41	66	1003
09-10	89	81	125	295	35	48	117	200	47	79	220	346	29	23	54	106	59	81	165	305	8	29	76	113	1365
10-11	62	68	160	290	48	44	87	179	74	76	206	356	32	25	91	148	29	70	271	370	5	23	53	81	1424
11-12	78	78	90	246	37	39	71	147	63	82	161	306	30	33	48	111	46	59	158	263	-	28	25	53	1126
12-13	79	129	127	335	26	61	70	157	60	71	142	273	22	35	40	97	24	62	132	218	2	12	22	36	1116
13-14	74	101	131	306	39	54	81	174	54	62	103	219	53	41	45	139	26	36	96	158	1	17	20	38	1034
14-15	83	104	104	291	47	31	83	161	59	71	115	245	45	45	82	172	36	40	95	171	2	11	30	43	1083
15-16	84	112	83	279	31	53	67	151	55	82	162	299	53	32	126	211	40	75	124	239	5	13	38	56	1235
16-17	77	96	110	283	49	74	86	209	68	80	159	307	42	52	121	215	22	71	129	222	8	40	63	111	1347
17-18	74	86	107	267	26	69	60	155	55	94	149	298	36	52	128	216	38	78	178	294	10	35	75	120	1350
18-19	68	94	90	252	49	56	45	150	70	84	132	286	27	31	79	137	25	49	137	218	8	16	55	77	1120
19-20	81	102	94	277	58	19	76	153	25	36	58	119	41	39	44	124	28	35	55	118	-	10	27	37	828
TOTAL	952	1126	1318	3396	481	565	908	1934	675	889	1768	3332	434	428	883	1745	411	698	1677	2793	52	254	525	831	14031

H - HTV, M - MTV, L - LTV, T - Total

Different Points of Observation for traffic inflow & outflow

1. Remed Check Gate	(SBP-BGH Rd : NH-6)
2. Hirakud Check Gate	(SBP-HKD Rd)
3. Ainthapali Check Gate	(SBP-JSG Rd: SH-10)
4. Sindurpank Check Gate	(SBP-DGH Rd: NH-6)
5. Khaliabandh Check Gate	(SBP-CTC Rd: NH-42)
6. Bhatra Check Gate	(SBP-Dhama Rd)

TRAFFIC FLOW AT DIFFERENT NODES

Flow of traffic at nine different nodes were surveyed for three periods in a day which are recorded in Table:III-14.Simultaneously traffic noise monitoring were conducted at the same locations along with one of the most busiest chowks of the town i.e. at Laxmi Talkies Chowk and data recorded are furnished in Table:III-14.

Table:III-13: Description on Nodes

NAME OF MONITORING POINTS	NATURE OF ACTIVITIES OF THE AREA
FATAK	All the mode of transport passes through this road (Fly –over) coming from Ainthapali area.
PANITANKI	It is a residential as well as busy area. The point of monitoring is carried on the side of one-way road. Most of the vehicles pass in this road through out the day.
NEAR SAKET HOTEL	It is the connecting road between two busiest area of the town i.e. Laxmi Talkies Chowk and Ashoka Talkies. Area. In addition, there are many hotels, restaurants & commercial establishments situated in this region.
ZILLA SCHOOL	It connects N.H.-6 & N.H.-42. So large number of vehicles are observed plying round the clock.
NEAR ASHAPALI SCHOOL	It is the connecting road from L.N.Chowk to Laxmi Talkies Chowk. Residential areas are there by the side of the road.
OLD PRIVATE BUS STAND	This road connects Laxmi Talkies Chowk and Modipara Chowk. Mixed type of activities occur in this area.
GOLE BAZAR CHOWK	This is one of the main road connecting Laxmi Talkies Chowk and Golebazar Chowk. Number of vehicles regularly ply in this area. Golebazar is being treated as nerve-center of retail trade. Many important trading & commercial establishments are located here. The most important of the Bazar is its daily market on which many households of Sambalpur depend for their bare necessities i.e. vegetables & non-vegetable items.
NANDAPARA	This road passes through the major residential establishments of the town namely Kunjelpara,Jharuapara, Nandapara and Daleipara.
KUNJEL PARA CHOWK	This road connects Modipara and Balibandha. Not a very crowded road.
LAXMI TALKIES CHOWK	It is the most crowded chowk connecting four main roads of the town and is the centre all activities.

TRAFFIC NOISE

While considering the environmental effects due to urbanisation, it is essential to take into account the noise that may be resulting from traffic on the roads. Movement of fleet of vehicles are contributing considerably to noise pollution. In commercial area larger part of

TRAFFIC FLOW

LAXMI TALKIES CHOWK AT PEAK HOURS

GOLEBAZAR

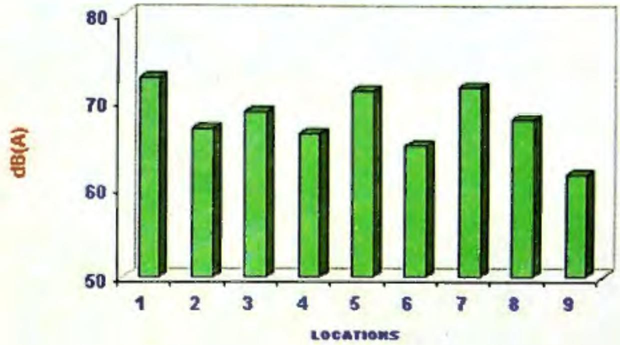
CONGESION AT VSS MARG

MIXED TRAFFIC AT KHETRAJPUR

NEAR ZILA SCHOOL

BURLA MARKET

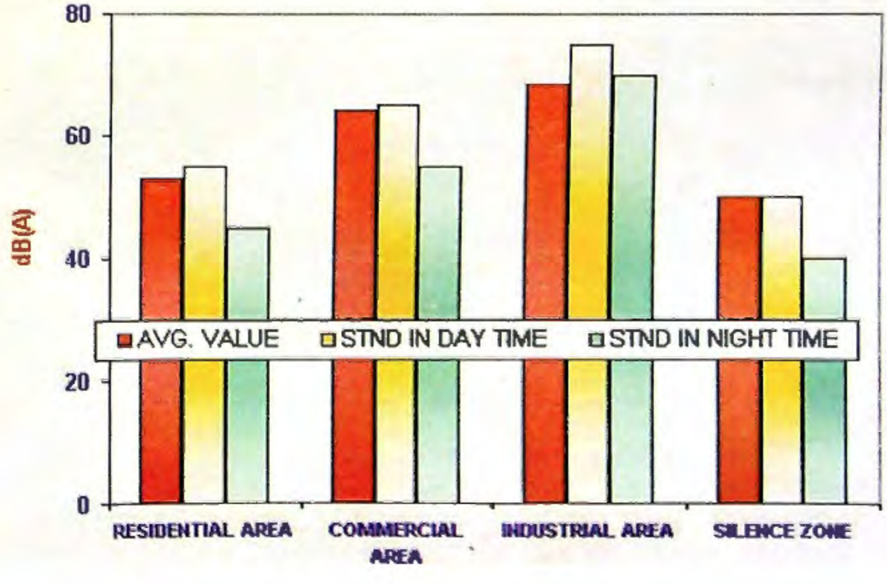
FIG : III - 4 : TRAFFIC NOISE LEVEL (Leq $_{DN}$) AT DIFFERENT NODES



LOCATIONS :

01 : Budharaja-LN Chowk
02 : L.N.Chowk - Modipara
03 : Ashoka T.- Laxmi T.
04 : Ashoka T.- Bhutapara
05 : L.N.Chowk - Laxmi T.
06 : Laxmi T. - Modipara
07 : Laxmi T.- Pirababa Chowk
08 : Pirababa Chowk - Kunjelpara
09 : Modipara - Balibandha

FIG : III - 5 : AVERAGE AMBIENT NOISE LEVEL IN DIFFERENT AREAS



noise pollution is caused by vehicular traffic. In industrial area, it is less because the types are not noise generating ones. The prediction of traffic noise is more complicated due to the fact that roads are not flat, straight or free from natural terrain variations. The factors like vehicle speed, density, traffic mix, width of the road and number of lanes are also not constant.

Systematic noise monitoring and frequency of vehicles were performed in selective nodes (Table:III-14) in the town area of Sambalpur at Morning (09hr-12hr), Afternoon (13hr-16hr), Mid-night (00hr-03hr) during Summer and Winter.

Table:III-14:Frequency of vehicles & Sound level at Nodes

Sl no	Node & Point of Monitoring	Time	Frequency Of Vehicles				Sound Level Parameters		
			HT V	MTV	LTV	TOTAL	Lmax In dB(A)	Lmin In dB(A)	Leq In dB(A)
1	Budharaja–L.N.Chowk (Fatak)	09-12	115	766	4063	4944	90.7	68.7	77.95
		13-16	123	245	657	1025	67.4	45.4	59.73
		00-03	76	22	78	176	56.9	36.6	40.23
2	L.N.Chowk, Modipara (Near Panitanki)	09-12	66	292	1460	1818	86.0	55.0	72.13
		13-16	112	184	543	839	62.2	45.2	54.78
		00-03	39	12	21	72	49.1	33.4	38.34
3	Ashoka Talkies-Laxmi Talkies (Near Saket Hotel)	09-12	75	616	2307	2998	85.2	62.7	73.77
		13-16	137	24	878	1039	68.5	54.2	63.23
		00-03	78	18	09	105	56.6	34.2	41.67
4	Ashoka Talkies-Bhutapara (Near Zilla School)	09-12	149	584	1893	2626	86.0	60.7	71.21
		13-16	236	356	756	1348	67.4	52.5	58.41
		00-03	104	08	24	136	46.6	32.2	38.34
5	L.N.Chowk-Laxmi Talkies (Ashapali School)	09-12	59	577	2953	3589	86.5	64.3	76.39
		13-16	114	435	1450	1999	68.2	49.5	62.51
		00-03	82	17	12	111	54.2	35.2	38.43
6	Laxmi Talkies-Modipara (Old Bus Stand)	09-12	61	523	2202	2786	83.8	59.4	69.33
		13-16	112	348	1203	1663	78.5	56.4	63.23
		00-03	23	10	29	62	48.4	31.1	36.41
7	Laxmi Talkies-Pirbaba Chowk (Gole Bazar)	09-12	12	306	2872	3190	85.0	60.7	74.12
		13-16	34	567	2314	2915	82.7	62.1	73.34
		00-03	12	07	23	42	49.7	34.7	39.21
8	Pirbaba Chowk-Kunjel para (Nandapara)	09-12	-	39	403	442	89.1	57.8	73.17
		13-16	13	67	123	203	62.1	42.5	49.63
		00-03	2	6	5	13	42.2	31.1	34.84
9	Modipara –Balibandha (Lady Lewis Girls High School)	09-12	12	115	939	1066	86.6	53.4	66.32
		13-16	26	67	456	549	72.2	45.3	56.31
		00-03	2	8	3	13	45.8	33.9	34.27
10	Laxmi Talkies Chowk (Cross point of four main roads)	09-12	X	X	X	X	87.6	65.4	76.38
		13-16	X	X	X	X	73.3	58.4	64.73
		00-03	X	X	X	X	68.9	34.5	46.81

For estimation of traffic noise regression equations with respect to Leq of Day and Night {Leq $_{DN}$} were established for all the roads as mentioned in Table:III-15.Total number of vehicles per hour and percentage of HTV were considered for predicting noise level. Multilinear relationships of noise parameter Leq $_{DN}$ were established as per the equation given i.e.

KACHERI ROAD

VSS MARG

NH.6 AT ANITHAPALI

FLY-OVER BRIDGE AT FATAK

BRIDGE OVER MAHANADI AT BURLA

RING ROAD AT BALIBANDHA

NH.6 AT REMED

REMED CHECK GATE

$$\mathrm{Leq}_{DN} = 53.51 + 6.22 \log Q - 25.56\, P$$

Where Q = Traffic Volume per Hr
P = Weightage of HTV over total vehicles

Table:III-15: Summerised Results of Important Sound Level Parameter along with Traffic Volume and % of HTV

NAME OF MONITOING POINTS	Important Sound Level Parameter			Traffic Volume/hr (Q)	Weightage of HTV over total Vehicle (P)
	Leq_{Day}	Leq_{Night}	Leq_{DN}		
Fatak	74.95	40.23	72.86	683	0.051
Panitanki	69.16	38.34	67.08	303	0.079
Near Saket Hotel	71.06	41.67	68.98	460	0.070
Zilla School	68.41	38.34	66.38	456	0.119
Ashapali School	73.46	38.43	71.36	632	0.044
Old Private Bus stand	67.24	36.41	65.18	501	0.043
Gole Bazar	73.71	39.26	71.66	683	0.009
Nandapara	70.10	34.80	68.06	73	0.022
Lady Lewis Girls School	63.70	34.27	61.68	181	0.024

It has been observed that the sound level parameters are being activated as per the traffic volume sustained in the road. Though the findings for Leq (Night) were quite low in all locations; it has been observed that the values for Leq. (Day) were in higher sides due to more plying of vehicle in day time. From this it is quite obvious that the sound level parameters are dependent on the traffic scenario also. However the overall result calculated for entire day & night (Leq DN) were observed on higher side implied cumulative impact due to plying of vehicles. The sound level estimated at Fatak, Ashapali school and Golebazar were found dominant because of high numbers of vehicles plying during observations (Fig:III-4).

CHAPTER - IV

WATER ENVIRONMENT

WATER & WASTE WATER QUALITY

Water, one of the most important natural resources and essential for the survival of most of the living organisms has been deteriorate its quality day by day due to rapid urbanisation, industrialisation and over-utilisation. The water and wastewater quality of the area has been surveyed from different sources i. e surface water, ground water, industrial as well as sanitary wastewater etc.

SURFACE WATER BODIES

RIVER MAHANADI : The Mahanadi is the largest river of Orissa ;originates from a pond near Pharsiya village in Raipur district of Madhya Pradesh and enters Orissa at Kanaktora. Passing through four States it covers a drainage area of 53.1% in Madhya Pradesh, 46. 5% in Orissa (i.e. 65,600 Sq. km.) and rest 0.7% in Bihar & Maharastra. The total length of Mahanadi from its origin to its outfall in to the Bay of Bengal is 851 km. of which 357 km. lies in M.P. and the remaining 494 km. in Orissa. The annual average discharge of the river is 66,640 Million Cubic Meters (MCM) of water to the sea.

HIRAKUD DAM PROJECT : The Hirakud Dam (Plate) ,one of the major dams of India across the Mahanadi river is situated at 21° 32'N & 83° 52' E and is about 15 km upstream of Sambalpur town and is the link between Burla & Hirakud. Being a multipurpose dam (power generation, irrigation and flood control at down stream delta zone) it also serves as the source for drinking water in this agglomeration. The dam consists of masonary, concrete and earthen sections with maximum height of 61M.The annual irrigational facilities provided through canals are estimated to be 264228 Ha. The important features of Hirakud dam and its reservoir are depicted in Table:IV-1.

Table:IV-1: Important Features of Hirakud Dam & Reservoir

MAIN DAM		RESERVOIR	
Total Length:	**4800.0 M**	Top of Dam	RL 195.68 M(642')
Concrete & Masonry Dam	1148.5 M	Max. water level	RL 192.02 M(630')
Earth Dam	3651.5 M	Dead storage Level	RL 179.83 M(590')
Length of Right Dyke	10759.0 M	Gross Storage capacity	8136 MCM
Length of Left Dyke	9837.0 M	Live storage capacity	5818 MCM
Catchment area of Dam	83400 km²	Dead Storage capacity	2318 MCM

Water Quality of River Mahanadi at Sambalpur

Of late, Rivers are getting polluted due to the entry of domestic, agricultural and industrial wastes; thus creating ecological imbalances in the ecosystem. Some of the wastes are highly polluted, making the water unfit for various uses. Water quality of Mahanadi at different points in the river bed has been studied for last two years in several occasions. The average values as obtained are indicated in Table:IV-2. There is no substantial discharge of any trade effluent into the river in this stretch. As there has been no proper drainage system ; all the municipal wastewater and run-off in rainy season pave their ways into the river at various points across the length from Burla (after Hirakud Reservoir) to Gobindtola. After construction of Ring Road, the different waste water outfalls have become more prominent with respect to their quantity as smaller drains were converged into single outfall. It is quite important that the wastewater at all the outfalls are discharged without allowing any treatment. Description on wastewater outfalls at Sambalpur is dealt in this chapter.

Table:IV-2 : Water Quality of River Mahanadi

LOCATION (Nearer to the River)	PARAMETER													
	PH	DO	BOD	COD	TSS	TDS	Chloride	Total Hardness	Turbidity	Alkalinity	Nitrate	Phosphate	Conductivity	Total Coliform
Barabazar	7.5	10.3	6.2	26.0	93.8	164.8	19.0	86.0	7.3	75.0	0.9	18.0	156.0	147.0
Kamalibazar	7.3	10.6	5.9	28.0	112.2	187.3	21.3	79.0	12.8	77.0	0.9	23.0	166.0	147.0
Balibandha	7.5	10.3	5.4	23.3	105.1	175.3	20.8	75.0	7.8	63.0	0.8	17.0	143.0	147.0
Kunjelpara	7.0	6.9	8.3	41.6	185.5	248.0	32.8	86.0	16.7	71.0	1.0	21.0	178.0	183.0

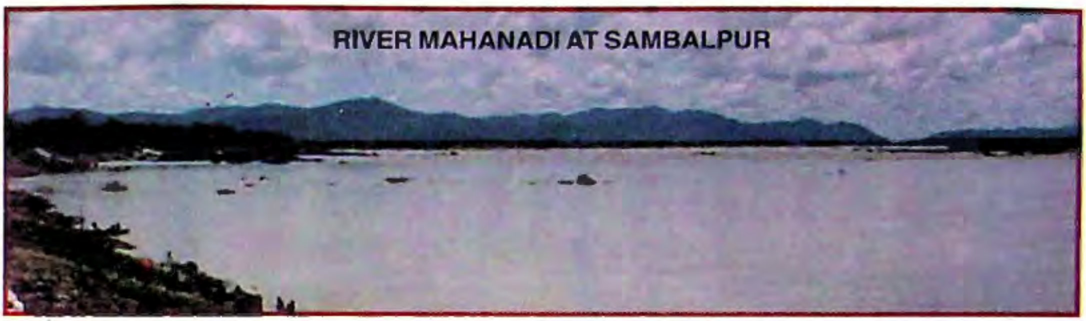
Turbidity is expressed in NTU , Conductivity in μ mhos / cm & others are expressed in mg / l except pH.

Table:IV-3: Range of parameters

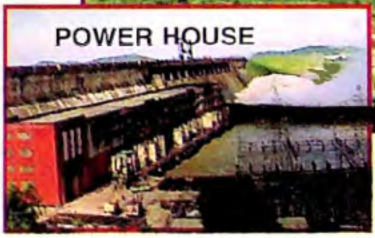
LOCATION	PH	BOD In mg/l	COD In mg/l	Chloride In mg/l	SS In mg/l	TDS In mg/l
Barabazar	7.2-7.8	4.0- 9.2	21.4 -32.2	10.0 –33.2	50 - 166	110.0– 254.7
Kamalibazar	6.8-8.2	4.0 - 9.0	21.6- 38.0	11.0 –34.6	70 -174	140.0 – 269.0
Balibandha	7.3-8.2	4.2 – 7.8	15.2 – 30.8	9.0 –39.2	60 –181	110.0 –281.0
Kunjelpara	6.2–7.4	6.0- 12.4	30.4 - 50.44	12.0- 71.8	110-312	160.0- 454.0

Table: IV-4 : Seasonal Variation of Parameters in River Water

Location	Seasons	pH	BOD In mg/l	COD In mg/l	Chloride In mg/l	TDS In mg/l	SS In mg/l	T.Hard. In mg/l
Barabazar	*Summer*	7.5	4.6	24.2	12.0	123	60	81
	Monsoon	7.5	7.1	30.5	22.5	210	180	84
	Post Monsoon	7.7	9.2	32.2	33.0	254	166	106
Kamalibazar	*Summer*	7.3	4.7	28.0	15.0	147	87	77
	Monsoon	7.2	6.3	21.5	24.2	208	120	76
	Post Monsoon	7.5	9.0	31.6	35.0	269	174	88
Balibandha	*Summer*	7.3	4.7	27.1	12.3	127	70	79
	Monsoon	7.4	5.3	17.5	24.5	196	120	65
	Post Monsoon	7.5	7.8	23.2	39.0	281	281	86
Kunjelpara	*Summer*	7.0	6.3	43.0	15.0	170	123	74
	Monsoon	7.3	9.3	35.6	40.0	262	216	92
	Post Monsoon	7.4	12.4	48.9	72.0	454	312	112


RIVER MAHANADI AT SAMBALPUR

HIRAKUD DAM


POWER HOUSE

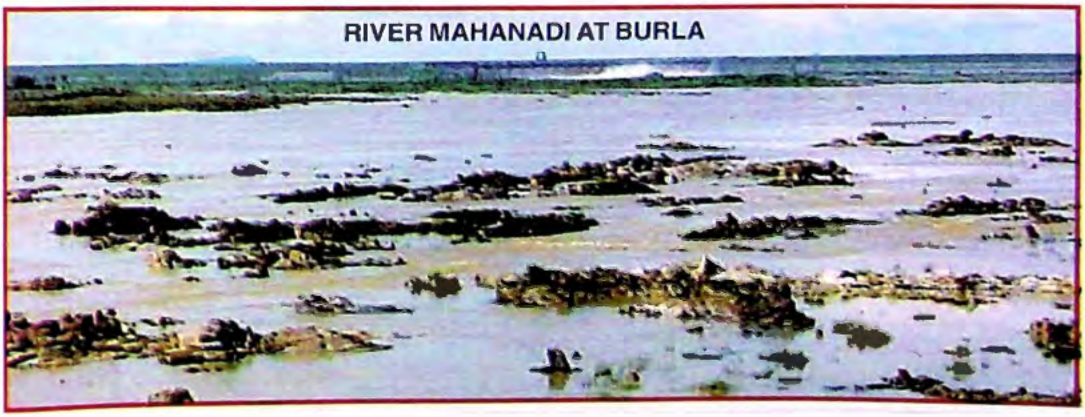
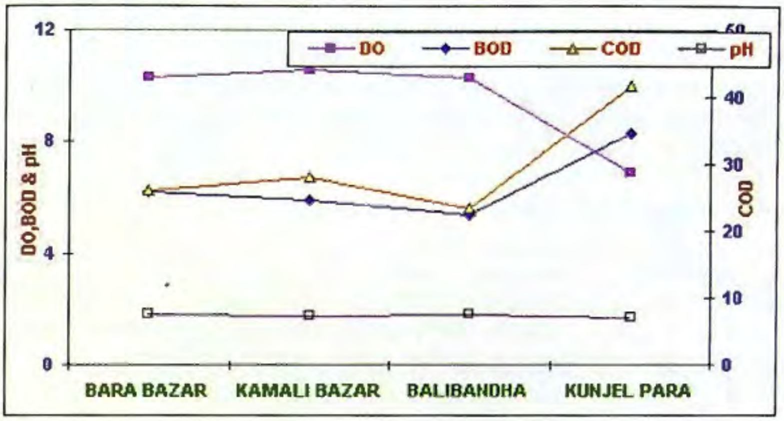
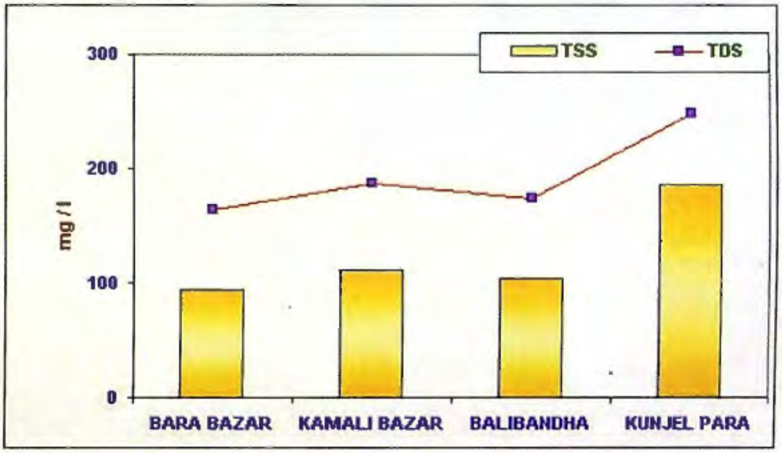
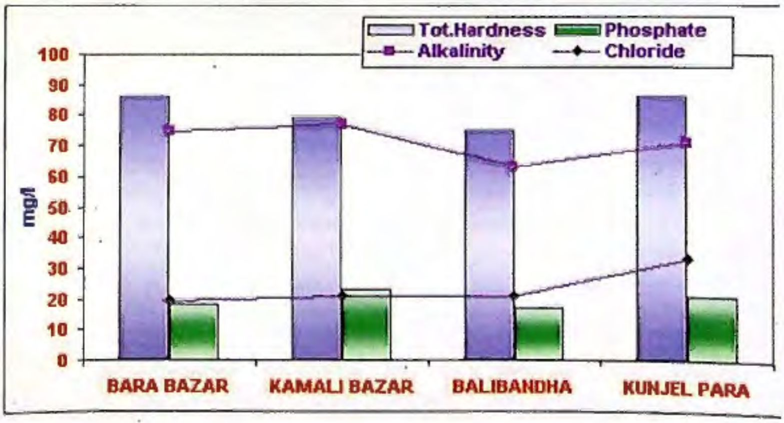

RIVER MAHANADI AT BURLA

FIG : IV 1 : AVERAGE VALUES OF DIFFERENT PARAMETERS IN RIVER WATER







The raw water quality of Mahanadi at Public Supply Water Intake Point suggests deterioration due to the entry of the biggest sewage outfall of the town at its immediate up stream. The water quality for raw water to be used for public supply and bathing & standard for drinking water quality as suggested by different bodies are compared in Tabl:IV-5 & Table:IV-7 respectively. Though Central Pollution Control Board has classified River Mahanadi as Class-C River ; the present results revealed that the water quality is still deteriorating and found above the characteristics defined for Class-C river with respect to BOD (Table:IV-6).The higher values of above parameter may be attributed due to the direct discharge of untreated sewage in river bed in this stretch through number of outlets (Description on different outfalls are presented in Table:IV-12 and the excess anthropogenic activities by the people residing nearby the river. Even the water quality at places is not suitable for bathing.

Table: IV- 5 :Standard of Raw water for Public Supply & for Bathing Ghats(IS:2296)

CHARACTERISTICS	**Tolerance limits for Inland suface waters for use as a raw water for public water supply and for bathing ghats**
Coliform Organisms MPN/ 100ml (monthly Avr.)	Not more than 5000,with less than 5% Of the samples with value equal to or more than 20000 and less than 20% of the samples with value equal to or more than 5000.
Fluoride(Max.) mg/l	1.5
Chloride(Max.) mg/l	600
Cyanides(Max.) mg/l	0.01
Dissolved Oxygen(Min)mg/l	40% saturation value or 3.0mg/l whichever is higher
BOD(Max.) mg/l	3.0
Nitrate(Max.) mg/l	49-50

Table: IV- 6: River Classification

Sl. No	**Characteristics**		**Tolerance limits for Inland Surface Water subject to pollution (IS: 2296-1982)**				
			Class-A	**Class-B**	**Class-C**	**Class-D**	**Class-E**
01	pH		6.5-8.5	6.5-8.5	6.5-8.5	6,5-8.5	6.0-8.5
02	DO	in mg/l	6.0	5.0	4.0	4.0	-
03	BOD	in mg/l	2.0	3.0	3.0	-	-
04	T.Coliform	in mg/l	50	500	5000	-	-
05	TDS	in mg/l	500	-	1500	-	2100
06	Flouride	in mg/l	1.5	1.5	1.5	-	-
07	Chloride	in mg/l	250	-	600	-	600
08	Nitrate	in mg/l	20	-	50	-	-
09	T.Hardness	in mg/l	300	-	-	-	-

Designated Best Use

Class - A	**Drinking water source without conventional treatment but after dis-infection.**
Class - B	**Outdoor bathing.**
Class - C	**Drinking water source with conventional treatment followed by dis-infection.**
Class - D	**Fish culture and wild life propagation.**
Class - E	**Irrigation ,industrial cooling, controlled waste disposal**

FIG : IV - 2 : SEASONAL VARIATION OF DIFFERENT PARAMETERS IN RIVER WATER

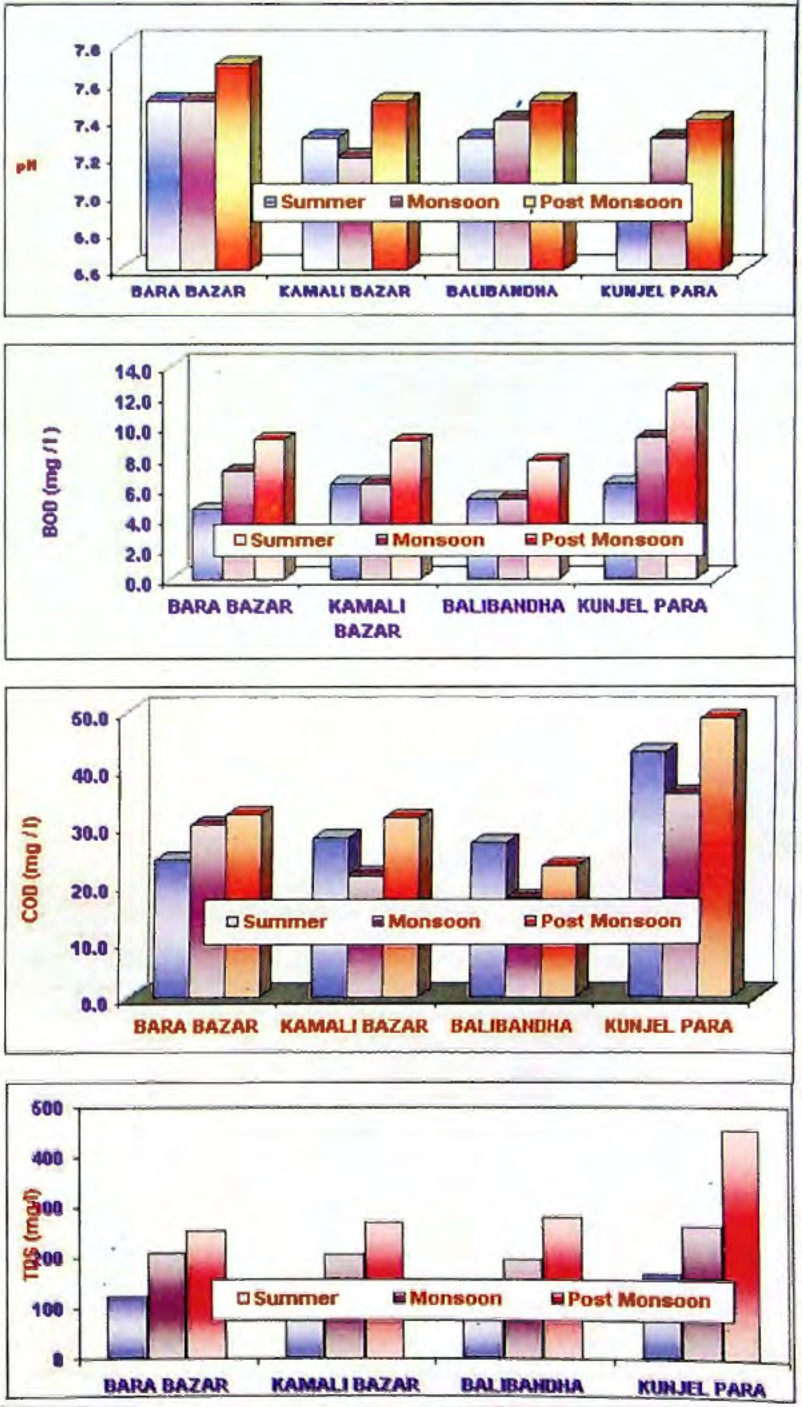


Table:IV-7: Drinking water quality standard

Parameters	Ministry of Works & Housing (India) *	United States Public Health Standard **	Soviet State Standard ***	IS:10500-1983	WHO (1984)
PH	7.0-8.5	6.0-8.5	6.5-8.5	6.55 - 8.5	6.5 - 8.5
TDS mg/l (max.)	500.o	500.0	1000.0 (dry residue)	500.0	1000.0
Total Hardness mg/l As caco3 max.)	200.0	-		300.0	500.0
Chloride mg/l (Max.)	200.0	250.0	350.0	250.0	250.0
Sulphate mg/l (max)	200.0	250.0	500.0	150.0	400.0
Turbity NTU (Max.)	-	-	-	10.0	5.0

* : Manual on Water Supply & Treatment,Ministry of Works & Housing,New Delhi,1976

** : Water & Wastewater Technology,M.J.Hammer,John Willey & Sons,1986,p-156

*** : Chemistry of Water & Microbiology,N.F.Voznaya,1981

LENTIC WATER BODIES

Ponds and other still water bodies (lentic) are useful domestic sources for the people residing in water scarcity areas. Even in this urban complex, the dwellers depend upon such water bodies where community water supply has not been either adequate or regular. These water bodies are used for variety of purposes i. e most commonly for bathing and drinking. Thus still water bodies sustain life not only of aquatic creation but also valuable for human beings. Deterioration of such water bodies cause ecological imbalances as well as health hazards. These ponds may deteriorate their water qualities due to several causes such as quick siltation, natural damage, rapid population growth in concerned area .

Considering the above facts, 'samples were collected from most of the ponds inside Sambalpur town as well as from Hirakud for testing its qualities with respect to various physico-chemical & biological parameters. The locations of ponds with its characteristics are mentioned in Table:IV-10.

Quality of Pond water

The results of samples of water collected from fifteen different ponds are presented in Table:IV-8.It is observed from the findings that the parameters like BOD, Chloride, are in higher side which suggest the deterioration of the water quality with respect to fresh water bodies suitable for bathing. It is observed that the pH values varied from 6.9 at Danibandh to 8.1 at Manikmunda (slightly alkaline) but remained within the stipulated limit of fresh water pH i.e. 6.5 –9.0 (Class-B).Here most of the Pond water contained high organic load and required more oxygen for its de-composition which is noticed through the values of BOD obtained .The range varied between 12.0-40.0 mg/l which might be in most of the cases due to in-flow of sewage, domestic wastes and practice of open defecation . The dissolved solids which contains soluble inorganic salts was also studied in the pond water and found within the range of 308.0-805.0 mg/l. Similarly the results for total hardness as well as chloride indicated slightly higher values except for Deolbandha, Mathapali , Sarlakani and Kenghati. In short ,it may be stated that water quality of most of the ponds under observation does not fit either for drinking or bathing as it deviates in one or more parameters as prescribed standards. This needs proper management in order to prevent further deterioration and Eutrophication. However, considering the socio-economic values with religioustic sentiments, bathing in these public places is likely to continue till proper awareness to come. Therefore, proper management of these ponds by the authorities is necessary.

Table: IV-8: Quality of Pond Water

SL NO	LOCATION	pH	DO	BOD	COD	TH	CaH	MgH	Cl^-	F^-	SS	TDS	PO_4	Alk.
01	Jurabandh,	7.9	2.4	32	116	102	90	12	232	0.12	78	554	3.3	188
02	Manikmunda,	8.1	2.8	18	68.4	120	110	10	108	0.68	91	334	5.3	172
03	Deul bandh	7.4	1.6	16	64.0	68	64	4	126	0.18	86	805	3.3	316
04	Ramsagar	7.5	5.2	27	98.0	320	300	20	114	-	92	412	-	-
05	Dani Bandh	6.9	4.5	16	44.0	250	218	32	107	-	101	711	-	-
06	Bhatra	7.1	4.6	32	98.0	402	390	12	125	-	62	618	-	-
07	Sakhipara	7.5	5.6	28	87.0	216	196	20	123	-	77	402	-	-
08	Khandual	7.4	6.2	23	53.0	109	83	26	96	-	119	901	-	-
09	Mathapali	7.3	5.9	24	73.0	78	42	36	107	-	72	310	-	-
10	BeheraMunda	7.5	5.8	20	67.0	124	80	44	102	-	82	409	-	-
11	Baraipali	7.6	6.0	24	61.0	136	120	16	79	-	103	411	-	-
12	Katardhua	7.3	6.4	12	48.0	192	160	32	93	-	92	572	-	-
13	Sarlakani	7.6	3.0	12	56.4	64	56	8	24	1.1	87	308	2.7	80
14	Kenghati	7.5	4.6	40	156.0	72	56	16	22	0.38	102	372	4.6	84
15	Hirakud	9.2	-	-	-	60	40	20	-	-	-	-	ND	120

TH-Total Hardness,CaH-Calcium Hardness,MgH-Magnesium Hardness, Cl^--Calcium, F^--Fluoride,SS-Suspended Solids PO_4-Phosphate, Alk-Alkalinity, TDS-T.Dissolved Solids (All values are expressed in mg/l except for pH)

Table: IV- 9 :General Requirements for composition and Properties of water used for Domestic and social purposes(USSR) ***

Composition & Properties of Water	For Centralised & Autonomous Water Supply System and also for use in Public Catering Establishments	For Bathing,Sports and Recreation of Population & also open Water Bodies inside Settlements
Suspended Matter *	0.25 mg/l	0.75 mg/l
pH	6.5 – 8.5	6.5 – 8.5
Mineral Composition **	1000.0 mg/l	–
Dissolved Oxygen	4.0 mg/l	4.0 mg/l
BOD	3.0 mg/l	6.0 mg/l
Pathogenic Causative Agents	Water should be free from pathogenic agents	–

* : The amount of suspended matter in water of open bodies (containing over 30.0 mg/l of natural mineral sources) may increase in normal level periods, by 5%.

** : 1000 mg/l includes 350 mg/l of chlorides and 500 mg/l of Sulphates for the purpose mentioned in the third column,the mineral composition should agree with the requirements of tastes.

*** : Source-Chemistry of Water & Microbiology,N.F.Voznaya,1981.

Table: IV-10 : Location & Characteristics of Different Ponds

Sl. No	Name of the Pond	Location	Characteristics of Pond
01	JURABANDH	Adjacent to Panitanki,Sambalpur	Greenish colour ,full of weeds, Used for bathing,washing by the dwellers of Thelkopara & Modipara.
02	MANIKMUNDA	Modipara.	Used for bathing, washing. Pond looks dirty & full of weeds.
03	DEULBANDHA	Modipara	Used for bathing, washing. Pond looks dirty & full of weeds.
04	RAMASAGAR	Behind taxi stand	Full of weeds and pale colour water. Sorrounded by walls and used mostly by slum dwellers for all purposes except drinking.
05	DANIBANDH	Danipali	Dirty and full of weeds, greenish colour, used for bathing by the locality.
06	SAKHIPARA BANDH	Sakhipara	Full of weeds, used for bathing & washing of clothes.
07	BHATARA	Bhatara	Clean water, used for bathing, washing & Pisciculture.
08	KHANDUAL BANDH	Khandual Village.	Dirty & full of weeds, used for bathing, cloth washing & others.
09	BEHERAMUNDA	Inside Beheramunda	Dirty, used for bathing and washings etc.
10	MATHAPALI BANDH	Mathapali	Dirty, used for bathing and washings etc.
11	BAREIPALI	Industrial Estate. Bareipali	Greenish colour, used for bathing, washing and pisciculture.
12	KATARDHUA	Fatak	Used for bathing, washing by local people. Provided barricade.
13	KENGHATI BANDH	Kenghati	Greenish in colour and full of weeds. Used for bathing and washing.
14	SARLAKANI BANDH	Sarlakani	Greenish in colour and full of weeds. Used for bathing and washing.
15	POND AT HIRAKUD	Hirakud	Greenish in colour, dirty & used for bathing.

GROUND WATER BODIES

The quality of ground water is generally good, as ground waters are free from suspended impurities and their quality is generally reliable. The straining action of porous strata through which the water travels is responsible for improving their quality due to natural filtration. This is more so in case of deep well waters. Shallow wells are liable to pollution by surface contamination and soaking of land drainage. Very often well waters require sterilisation and some time chemical treatment to remove dissolved gases and minerals. The quality of ground water surrounding Sambalpur-Burla-Hirakud has been surveyed in different dug wells / tube wells/ bored wells in order to study the possible contamination or percolation of domestic as well as industrial wastes. Representative samples from twenty five Bored/Tube/Dug wells at different locations were collected on number of occasions. The results are presented in Table-IV-11.

Table:IV-11:Water Quality of Ground water

A. BORED / TUBE WELLS

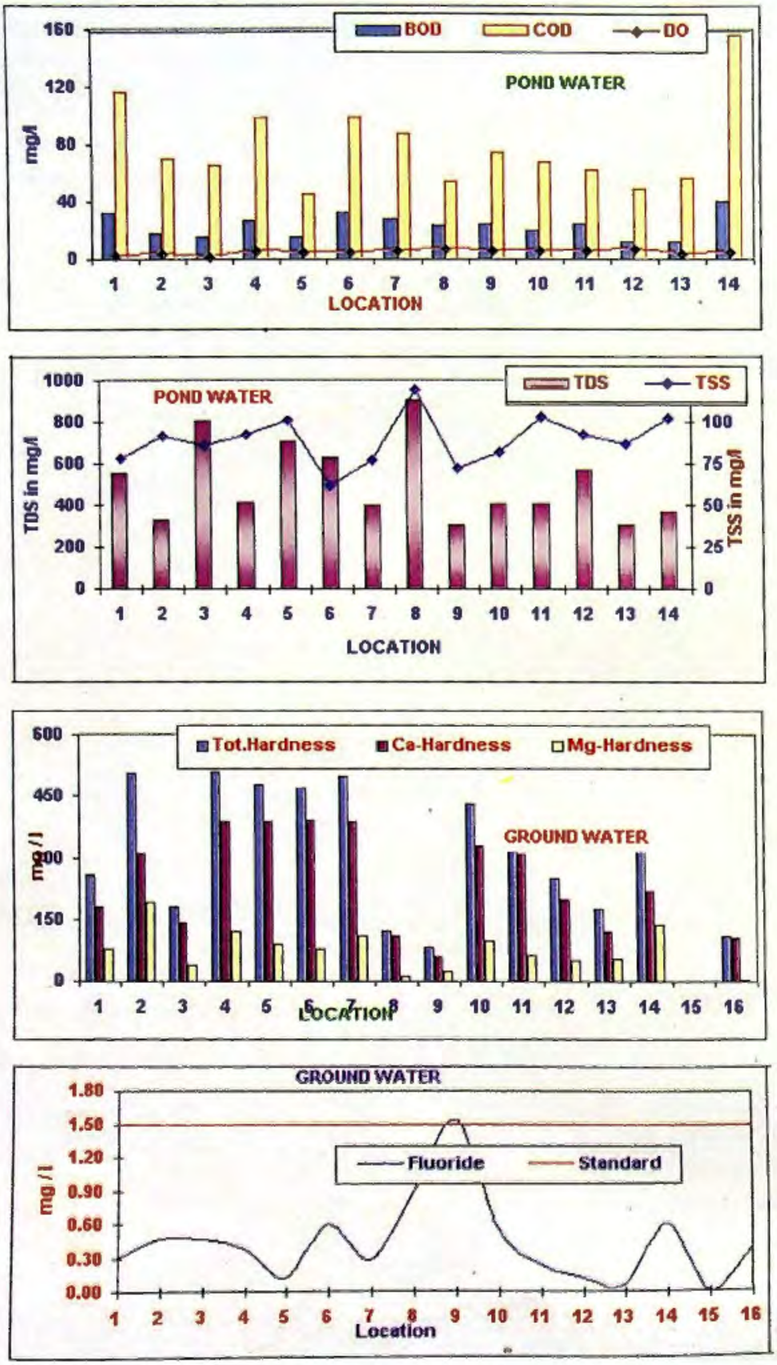
Sl. No	LOCATION	pH	BOD Mg/l	COD Mg/l	SS Mg/l	TDS Mg/l	F^- Mg/l	Cl^- Mg/l	TH Mg/l	CaH Mg/l	MgH Mg/l	Alk Mg/l
01	NCC Office ,GMC	7.8	1.0	9.6	5.0	280.0	0.33	38.0	260.0	180.0	80.0	144.0
02	Lecturer's Colony	7.3	1.2	18.5	6.0	728.0	0.47.	202.0	504.0	310.0	194.0	204.0
03	S.J.Hostel,GMC	7.6	2.0	12.4	4.0	234.0	0.47	22.0	180.0	140.0	40.0	192.0
04	Deulbandh	7.9	3.0	20.6	12.0	256.0	0.38	202.0	510.0	390.0	120.0	168.0
05	Pathanpara (BB)	7.8	4.0	25.1	16.0	598.0	0.12	92.0	480.0	390.0	90.0	236.0
06	Bhati Road, (BB)	7.9	4.6	26.8	15.0	618.0	0.60	150.0	472.0	392.0	80.0	280.0
07	Gingirapada, (BB)	7.1	2.1	16.2	6.0	637.0	0.28	168.0	498.0	390.0	108.0	120.0
08	Sindurpank Chowk	8.0	2.0	9.6	7.0	142.0	0.88	32.0	120.0	112.0	8.0	160.0
09	Kenghati	7.6	0.8	6.4	3.0	28.0	1.53	12.0	82.0	60.0	22.0	96.0
10	Gobindtola	7.8	1.0	14.2	4.0	242.0	0.55	111.6	430.0	330.0	100.0	116.0
11	Pirbaba Chowk	8.0	0.9	7.6	2.0	225.0	0.23	121.3	372.0	310.0	62.0	168.0
12	Motijharan	7.9	1.0	9.6	8.0	185.0	0.12	71.2	250.0	200.0	50.0	180.0
13	Remed	7.4	2.0	9.6	6.0	127.0	0.06	32.3	176.0	120.0	56.0	164.0
14	University Campus	7.9	1.0	13.4	6.0	221.0	0.6	85.5	356.0	220.0	136.0	228.0
15	Nuajamada, HKD	7.5	2.8	18.1	8.0	207.0	0.38	-	-	-	-	-
16	Panitanki	7.6	2.0	14.6	3.0	134.0	ND	20.0	108.0	104.0	4.0	60.0

GMC- G.M.College, (BB) ;Barabazar ,HKD- Hirakud

B. SHALLOW/DUG WELLS

Sl. No	LOCATION	pH	BOD Mg/l	COD Mg/l	SS Mg/l	TDS Mg/l	F^- Mg/l	Cl Mg/l	TH Mg/l	CaH Mg/l	MgH Mg/l	Alk Mg/l
1	**Gundurupada,HKD**	**7.4**	**2.7**	**12.0**	**10.0**	**890.0**	**1.0**	**34.0**	**234.0**	**198.0**	**36.0**	**92.0**
2	**Mohamadpur,HKD**	**7.8**	**3.8**	**9.8**	**12.0**	**987.0**	**0.33**	**45.0**	**180.0**	**156.0**	**24.0**	**68.0**
3	**Tarasinghpara, HKD**	**7.6**	**3.7**	**10.6**	**12.0**	**834.0**	**0.55**	**83.0**	**210.0**	**186.0**	**24.0**	**82.0**
4	**MissionCompound**	**8.5**		**41.1**	**81.0**	**740.0**	-	**221.0**	**260.0**	**140.0**	**120.0**	**65.0**
5	**Sideswarberna, Fatak**	**8.0**		**51.4**	**34.0**	**318.0**	-	**112.0**	**352.0**	**318.4**	**33.6**	**48.0**
6	**Near Church,SBP**	**8.5**			**64.0**	**700**	-	**113.0**	**320.0**	**296.0**	**24.0**	**56.0**
7	**S.J.Hostel Campus,GMC**	**7.6**	**3.6**	**16.4**	**35.0**	**80.0**	**0.28**	**42.0**	**102.0**	**96.0**	**6.0**	**108**
8	**Purunathana,Burla**	**8.2**	**2.3**	**13.4**	**23.0**	**120.0**	**0.34**	**67.0**	**120.0**	**92.0**	**28.0**	**72.0**
9	**Contractor's Colony,Burla**	**7.4**	**2.3**	**12.8**	**40.0**	**96.0**	**0.78**	**65.0**	**134.0**	**112.0**	**22.0**	**87.0**

FIG : IV - 3 : POND WATER & GROUND WATER QUALITY



The results as compared with Drinking water quality some parameters indicated that the water quality of both dug wells and tube wells are marginally polluted except in some of the cases i. e at Deulbandh, Pathanpada, Bhati Road, S, J. Hostel at Sambalpur & Mohamadpur, Tarasinghpara at Hirakud which recorded slightly high BOD. All most all the dug wells / tube wells show fluoride content below 1.0 mg/l. But, this has been observed 1.53 mg/l at Kenghati.

WASTE WATER QUALITY

The study of waste water mainly projects the sewage of Sambalpur Municipality, Burla NAC & Hirakud NAC. The industrial effluent and its quality has been discussed in other chapter.

Sewage Water

There is no proper management and planning for the discharge of sewage in this urban agglomeration. There are number of outllets collecting sewage/other effluent throughout the area and are being discharged into the river Mahanadi at Sambalpur and through power channel at Burla. The details of major outlets/ outfalls are presented in Table:IV-12. The typical sewage comprising of domestic, hospital and other wastewater (at times from various industrial sources) etc are being discharged directly to the River Mahanadi without any treatment which has mostly objectionable quality with regard to health problems. In order to study the quality of sewage, samples from drains and outfalls were collected and the results are depicted in Table:IV-14.

Quality of Sewage Water

The results (Fig:-IV-4) indicated polluting nature of water characterised by high values of BOD,SS and COD (except in Kharjoor nala, Durgapali nala and outfall at Swargadwar) etc. with respect to the standard discharge into inland surface water. All sewage drains/ outfalls confirmed to the water quality parameters such as pH, TDS and Chloride. However, the sewage mostly observed alkaline in nature. Standards for sewage discharge for some selected parameters, as stipulated by OPCB are represented in Table:IV-13. This suggests the extent of treatment required for the sewage before their ultimate disposal.

Table:IV-12: Description on Different Outfalls

Sl. No	Location of outfalls / outlets with River Mahanadi	Sewage/Effluent carried from
01	Outfall at Mandlia (Durgapali nala)	Remed,Hirakud,Rice mills
02	Outfall trhough Ring Roadf at Chandannagar	Khetrajpur and Barbazar (partly)
03	Outfall trhough Ring Roadf at Sadakghat	Badabazar
04	Outfall trhough Ring Roadf at Swargadwar	Kamlibazar
05	Outfall trhough Ring Roadf at Ramjipada	Ramjipara
06	Outfall trhough Ring Roadf at Balibandha (Dhobijor)	Modipara(partly),Farm Road, Cheruapara,Housing Board Colony
07	Outfall trhough Ring Roadf at Hatpada	Jharuapara,Nandapara,Marwaripara
08	Outfall trhough Ring Roadf at Daleipara	Daleipada,Hatpada,Marwaripara(partly)
09	Outfall trhough Ring Roadf at Municipality Office	Daleipara,Nayakpara
10	Outfall trhough Ring Roadf at Katchery ghat	Only Run-off
11	Outfall at Binakhandi (Dhobijor)	Modipara (partly),LN Lane,Gujurati Colony, Mission Compound,Laxmi Talkies,AIR Colony, Ashoka Talkies,Pensionpara, Kumbharpara, Golebazar, CC Colony,Hirakud Colony
12	Outfall at Gobindtola (Haradjor)	Motijharan, CC Colony(partly), Charbhati

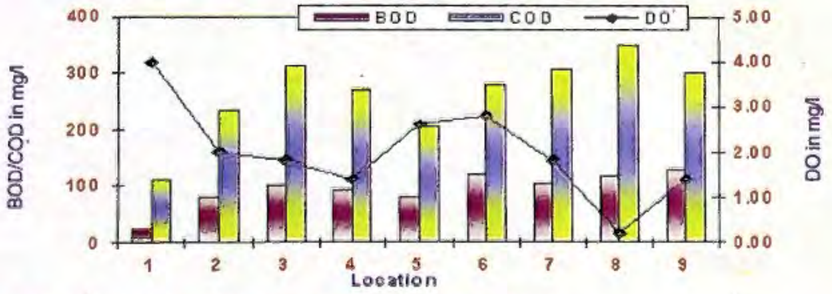
Table:IV-13 :Standard for Sewage Discharge

	STANDARD	
PARAMETRES	**Discharge into Inland Surface Water**	**Discharge on Land for Irrigation**
pH	5.5 – 9.0	5.5 – 9.0
Suspended Solids	30.0 mg/l	200.0 mg/l
Total Dissolved Solids	2100.0 mg/l	2100.0 mg/l
BOD	20.0 mg/l	100.0 mg/l
COD	250.0 mg/l	-
Chloride	1000.0 mg/l	600.0 mg/l

Table: IV-14 : Water Quality of Sewage Drains / Outfalls

Sl.No	LOCATION	pH	DO	BOD	COD	SS	TDS	Cl^-	TH	Alk	PO_4	TC
01	Kharjoor nala at Hiraku	7.8	4.0	26.0	111.0	96.0	313.0	-	-	-	-	-
02	Outfall at Mandlia (Durgapali nala)	7.6	2.0	80.0	234.0	134.0	405.0	54.0	86.0	100.0	2.7	2400
03	Outfall at Chandannagar	6.6	2.0	100.0	312.0	157.0	620.0	17.0	112.0	134.0	66.5	5000
04	Outfall at Sadakghat	7.6	1.4	92.0	270.0	90.0	347.0	16.0	46.0	96.0	4.6	16000
05	Outfall at Swargadwar	6.9	2.6	80.0	206.0	122.0	380.0	24.0	152.0	90.0	20.6	24000
06	Outfall at Ramjipada	8.6	2.8	120.0	281.0	119.0	274.0	98.0	70.0	68.0	21.2	9000
07	Outfall at Balibandha (Dhobijor)	8.7	1.8	106.0	306.2	115.0	710.0	94.0	108.0	108.0	-	9000
08	Sewage nala at Bhati Road	7.7	0.2	116.0	350.0	73.0	521.0	59.0	168.0	208.0	3.0	24000
09	Dhobijora Nala at Modipara	7.5]	1.4	130.0	302.0	180.0	679.0	70.0	392.0	244.0	3.3	5000

Fig : IV-4 : Sewage Water Quality At Various Points

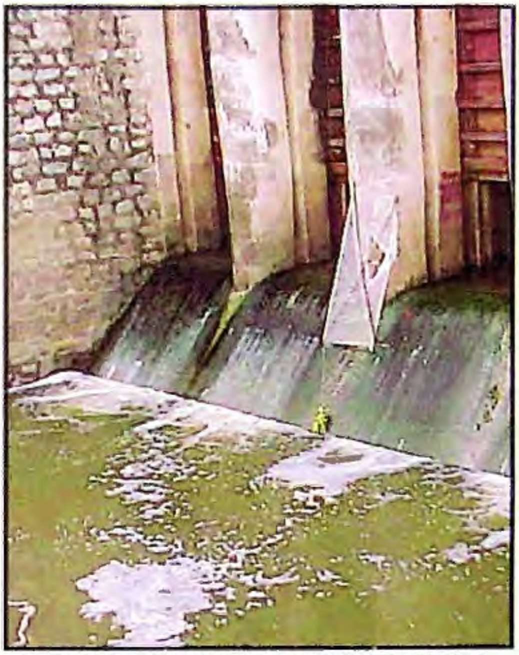


INDUSTRIAL EFFLUENT AND ITS EFFECT ON RIVER

Discharge of effluent from industries to River Mahanadi is very less. The details on generation of trade effluent, domestic wastewater etc. are being dealt elsewhere in the book.

DHOBIJOR AT MODIPARA

DHOBIJOR AT SENPARK



SEWAGE OUTFALL AT BALIBANDHA

SEWAGE OUTFALL AT RAMJIPARA

DURGAPALI NALLA

HARDJORA NALLAH AT GOBINDTOLA

URBAN SOLID WASTE

CHAPTER - V

Solid wastes generated by domestic, commercial and industrial activities are often indiscriminately disposed off. It is very common to find large number of garbage heaps at every nook and corner of the towns. Insanitary method being adopted for disposal of solid wastes is a serious health concern. Urbanisation has tremendously increased the pressure on the civic authorities for handling and managing solid wastes to keep the cities/towns clean and the environment free from pollution. In real term though steps have been taken by Municipal Authorities for management of these wastes; only a small fraction is being properly utilised or disposed off in a scientific manner. Consequently urbanised sector are facing serious environmental problems leading to degradation of water, air, soil and vegetation. The collection, transportation and disposal of Municipal solid wastes (MSW) in Sambalpur are being mainly dealt with this chapter.

SOURCES OF MSW

Sambalpur Municipality having an area of 46.5 sq. kms, adopted a population load of more than 2 lakhs (projected figure) unevenly distributed in 29 nos. of wards; has adopted insanitary methods for disposal of MSW. It is has been noticed very large heaps of garbage in disorganised manner at every nook and corner of the town. Different waste generators given in Table:V-1 contribute the urban solid wastes of the Municipality. In addition to 25000 numbers of households (1991 census) there are 82 slum pockets in existence here in the town with a population of roughly 70000 (1991 Census). There is no household container and the domestic refuges are thrown on the street or drain everyday. Even more wastes hazardous in nature, are being generated abundantly from different Hospitals and Nursing homes in the town.

Table : V-1: Waste Generators

SL NO.	WASTE GENERATOR	NO.OF UNITS
01	HOUSEHOLDS (1991 CENSUS)	25000
02	HOTELS	5
03	RESTAURANTS	130
04	LODGING HOUSES & HOLIDAY HOMES	15
05	HOSPITALS & NURSING HOMES	16
06	MAIN OFFICES	14
07	INSTITUTIONS	
	(A) PRIMARY SCHOOLS	56
	(B) MIDDLE SCHOOLS	26
	(C) SECONDARY SCHOOLS	17
	(D) COLLEGES	04
08	INDUSTERIES including Cottage Types	120
09	MARKETS	04
10	PUBLIC PLACES	
	(A) CINEMA HALLS	03
	(B) PARKS	01
	(C) BUS STANDS	02
	(D) RAILWAY STATIONS	02
	(E) STADIUM	01
	(F) AUDITORIUM,DRAMA,COMMUNITY HALL	07
	(G) TEMPLES,MOSQUES,CHURCHES	08
	(H) PUBLIC LIBRARIES & READING ROOMS	10

QUANTITY OF MSW

The quantity of wastes generated by different users has been typically estimated and reflected in Table:V-2). In general the generation of solid wastes depends on various factors viz. class of cities, variation in income groups and to small extent the level of adecacy (Table:V-3). As quantified by others also; the solidwaste generated in small, medium and large town / cities are 0.1 kg, 0.3 –0.4 kg and 0.5 kg per capita respectively. The quantities of waste generated from different categories are mentioned in Table:V-4.

Table :V- 2: Generation of Waste by Users

SL NO	CONSTITUENTS	RESIDENTIALS	MIXED	OPEN SPACES & CLEANING SEPTIC TANK	TOTAL (TONNE/DAY)
1	**COMPOSTABLE**				
	1. Vegetable waste	17.00	1.30	1.00	18.30
	2. Drain sludge	-	-	-	21.60
2	**RECYCLABLES**				
	1.Dump Materials				
	➢ Paper	3.14	1.30	-	4.44
	➢ Plastic	2.15	0.44	-	2.59
	➢ Glass	1.08	0.43	-	1.51
	➢ Metals	4.50	1.09	-	5.59
	➢ Fabric	0.63	0.01	-	0.64
	➢ Rubber	0.45	0.01	-	0.46
	2.Kabadi collection at source	-	-	-	6.00
3	**COMBUSTIBLES**				
	1. Other than 1 & 2	2.50	2.60	-	5.10
	2. Hazardous clinical waste	1.00			1.00
4	**NON COMBUSTIBLES**				
	1. Ash	3.06	-		3.06
	2. Construction waste	2.11	4.00		6.11
	3. Soil and Dust	14.66	3.26		17.92
	TOTAL	**68.88**	**18.62**	**1.00**	**94.50**

Table:V-3: Factors Affecting Generation of Wastes

GROUPS	WASTES / HOUSEHOLD (kg)	WASTES / CAPITA (kg)
Low Income Group	1.583/ 1.6	0.257
Middle Income Group	2.417 / 2.4	0.345
High Income Group	2.782 / 2.8	0.623

WASTE DUMP SITES

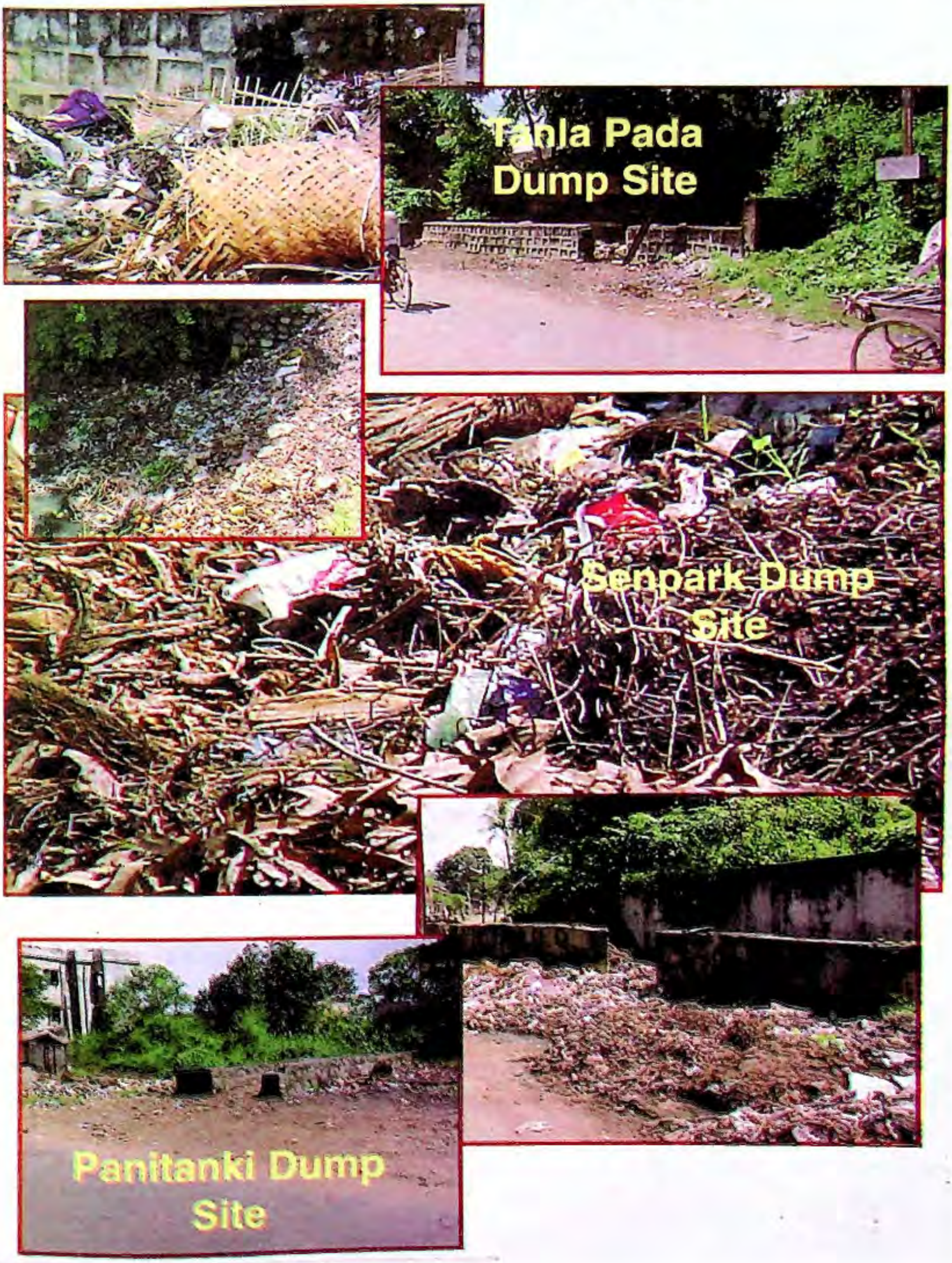


Table :V - 4 : Quantity of Waste Generation by Different Categories

SL NO.	SOURCE OF GENERATION	QUANTITY OF WASTE GENERATED PER DAY(Ton)
01	*Domestic wastes generated from residential (House holds) and non residential sectors (Offices, Hotels, Dharmsalas)*	56.02
02	*Wastes generated from commercial places like market , bus stand ,Shopping complexes .*	05.35
03	*Wastes generated street sweeping from roads ,parks and parking places etc.*	21.65
04	*Wastes generated from industries*	08.86
05	*Wastes generated from various other sources not covered under the above category*	02.63
TOTAL		94.50

COMPOSITION OF MSW :

A detailed study on physical and chemical characteristics has been carried out by collecting various solid waste samples from different garbage points in Sambalpur town. The different characteristics of solid waste are described in Table: V- 5 and 6.

Table:V - 5: Composition of Urban Solid Waste

SL NO.	CONSTITUENTS	WEIGHTS (%)
01	Plastic waste	04.08
02	Glass waste	02.04
03	Metal waste	08.52
04	Paper waste	05.96
05	Cloth & Textile waste	01.19
06	Vegetable waste	32.20
07	Kitchen chullah waste	05.79
08	Construction waste	11.58
09	Rubber waste	00.85
10	Soil and Dust waste	27.77

CONSTITUENTS OF MSW :

The waste samples collected from different locations in Sambalpur Municipal Area and their compositions are given in Table:V-6.

METHOD OF COLLECTION ,TRANSPORTATION AND DISPOSAL

The junk collectors lift the reusable glass and plastic items as well as paper, cardboard and metal scrap from households waste. Rag pickers are mostly child workers, they ravage dumps on the road side to pick up poly-bags , broken plastic , glass ,small metal cans which account for 1 to 5 % of the dump wastes .

Table:V-6: Constituents of Waste Samples of Sambalpur Municipality

Sl no	LOCATION	VEG. WASTE	PLASTIC WASTE	METAL WASTE	GLASS WASTE	PAPER WASTE	RUBBER WASTE	TEXTILE WASTE
01	Senpark Dump Site (Sample - 1)	0.30	0.075	0.12	0.1	2.25	-	0.3
02	-do- (Sample - 2)	0.90	0.250	0.05	0.1	4.90	-	0.9
03	Taltal site	0.75	0.15	0.05	0.05	-	0.80	0.85
04	Baldev site	0.35	0.05	0.075	0.85	-	-	-
05	Khetrajpur site	0.35	0.15	0.05	0.05	-	1.15	-
06	Dhanupali site	0.425	0.04	0.175	0.8	-	-	-
07	Bhatra site	0.35	0.04	1.6	-	-	-	-
08	District H.Q. Hospital	2.0	0.04	-	-	-	-	0.1
09	G. M. College square	0.05	-	0.05	0.2	-	-	0.34
10	Fatak square	0.85	-	-	1.15	-	-	-
11	Gopalmal	0.35	0.05	0.25	1.00	0.05	0.05	0.5
12	Khetrajpur railway station	0.50	0.25	0.05	0.05	-	0.05	-
13	Badabazar	0.3	0.5	0.25	0.1	0.05	0.3	-
14	Samelswari temple	1.6	0.2	2.35	-	-	-	-
15	Mandila muhana	0.7	0.05	0.2	0.1	0.5	-	0.4
16	Durgapali	0.2	0.1	0.05	0.5	0.4	-	0.5
17	Baraipali	0.55	0.05	0.05	0.3	0.7	-	-
18	Central school (Danipali)	0.1	0.6	-	-	-	-	0.7
19	Kainsir road	0.3	0.1	0.4	0.05	-	0.05	0.35
20	Sekhar colony	0.05	-	-	0.1	-	0.05	0.75

The MSW is mainly removed by sweepers in a wheelbarrow, which has a capacity of 1 quintal. A sweeper normally makes 3 to 5 trips per day to the roadside dump and carries for distances up to 1km. The drains are cleaned by another sweeper on a different time, who leaves sludge on roadside. The dry sludge is lifted in due course by tractors.

Open defecation is practiced by slum dwellers in forest and open spaces and lanes by lanes mostly by children of lower income groups . The municipality uses its own fleet of vehicles for lifting.

There is a cremation ground by the side of the river close to the settlement by low-income group. There are numbers of roads leading to the river and invariably waste is dumped at the road end.

In the market places conservancy services are inadequate. There are 5 sweepers detailed in this market who make cleaning, once in morning and again at mid-day to remove vegetable wastes to Senpark transfer dump. 6 to 7 tonnes of waste predominated by putrescibles is collected at Senpark which is daily transported away by trucks. The other busy market areas are swept daily but it is not effectively. The two railway stations and bus stands areas are next busy public places, where wastes are also pre-dominated by putrescibles, paper and plastic. The railways after sweeping their yards dump wastes in the open area on the roadside.

The municipality uses 2 tractors. A tractor carries about 1.5 tonnes and makes 2 to 3 trips to the disposal site per day .A dumper truck carrying about 3 tonnes load makes 3 trips a day from transfer dumps to the disposal site. A mini truck also makes 2 to 3 trips per day carrying 2.5 tonnes per trip. Three numbers of mini truck (Tata-407) have been added for better management in narrow streets. One tractor is meant for the construction work. There are also 142 wheelbarrows, but large number of them are unserviceable. Recently 13 numbers of three wheeler Tempo were added for better transportation of MSW.

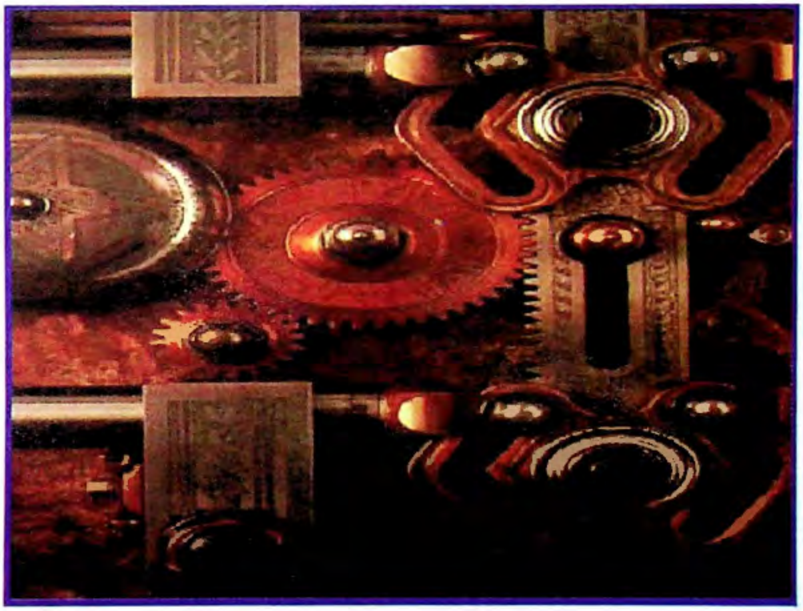
A total of about 77 tonnes are being transported and disposed off daily. The municipality departmentally handles its conservancy programme. The health officer of the municipality looks after the conservancy programme. He is assisted by 2 sanitary inspectors, 4 Zamadars each remaining in-charge of a zone. The municipality has appointed 34 beat peons one per each of the wards. They are overseeing personnel and each of them looks after the works of about 15 sweepers. There are 500 sweepers working round the clock . Out of them 172 are on regular basis, rest of them are on daily wage basis .

The hazardous waste generation in the town is of low order. There is negligible industrial solid waste hazard. The clinical wastes generated by 4 hospitals, 10 nursing homes and about 100 dispensaries, pathological clinics and medical consultancy chambers work out to be 1 tonne including glass, plastic material, cotton, gauge and other surgical wastes. There are at present getting mixed up in the street wastes from all sources except the district head quarters hospital and the municipality maternity hospital where waste is dumped separately.

With regard to disposal it was noted that transportation of the wastes are carried out by the municipality vehicles to the land fill site (LAKSHMIDUNGRI) .The waste comprises of plastic , paper , vegetable waste , glass , grit , soil , straw , bamboo , leave etc. Nearly 27 tonne of wastes are disposed of at Lakshmidungri daily. The dumping yard is inside the forest but there is no specific landfill and reclamation activity. The disposal of MSW of the town has been grossly inadequate.

CHAPTER - VI

INDUSTRIAL ENVIRONMENT



INDUSTRIAL ACTIVITIES IN THE URBAN COMPLEX

Industrial activities create pollution resulting in deteriorating the quality of environment as well as threatening to life support systems those not having adequate pollution control measures. Major industrial pockets in this area are mostly distributed in Hirakud and Remed area. Small scale industries and tiny industries viz. Rice Mills, Stone Crushers, Oil Mills, Gudakhu Factories and Engineering units exist. The area under Sambalpur Development Authority has been declared as Air Pollution Control Area i.e. restricted area in the use of fossil fuels. In order to assess the present industrial pollution load it is highly essential to identify such industrial sources and their management systems.

Besides, other sources of pollution those are generated from automobiles service stations(garage), hotels, hospital/clinics etc. do contribute pollution load to the environment. Total number of industries operating in the present study area are 55 out of which Large-2nos., Medium - 3 nos., Small-41nos., Stone Crushers - 9 nos. Although a number of industries have been registered few of them are in operating mode which are depicted in Table: VI-1.

Table:VI-1:Type,Category,Location & Number of Existing Industries

TYPE OF INDUSTRY	AREA OF OPERATION	CATEGORY	NO. OF UNIT
ALUMINIUM SMELTER	HIRAKUD	LARGE	01
THERMAL POWER	HIRAKUD	LARGE	01
SUBSTATION STRUCTURE	HIRAKUD	MEDIUM	01
RE-ROLLED PRODUCTS & CABLES	HIRAKUD	MEDIUM	02
RICE MILL	KHETRAJPUR/REMED AREA	SMALL SCALE	15
PHARMACEUTICALS	I. E., SAMBALPUR	SMALL SCALE	02
GUDAKHU	KHETRAJPUR	SMALL SCALE	05
HOTEL	SAMBALPUR	SMALL SCALE	8
AUTOMOBILE SERVICE STATION	SAMBALPUR	SMALL SCALE	11
MISCELLANEOUS	I. E., SAMBALPUR	SMALL SCALE	19

There are 32 numbers of SSI units registered in Sambalpur Industrial Estate out of which 21 numbers are in operating stage and most of the small scale industries are of non polluting category.

AIR POLLUTING ACTIVITIES

The air qualities at Hirakud and Remed of Sambalpur are observed to be little dusty which might be due to source and fugitive emissions from Power & Smelter Plants of INDAL at Hirakud and activities of Stone Crushers, Rice Mills, Oil Mills at Remed area and above all; plying of Heavy vehicles (mostly carrying coal and other raw materials) in the road connecting Remed and Hirakud. These emissions at times result in contamination of air causing health hazard. The sources of air pollution caused by the concerned industries along with remedial measures undertaken are presented in Table:VI-2.

Table:VI-2: Air Pollution Control Measures Adopted by Industries

Name of Industry	Production Capacity	Source	Air Pollution Control Measures Existing
Smelter Plant, INDAL	Al. Ingot-20000 TPA Concast Coil - 10000 TPA Carbon paste –25000 TPA	1. Pot Room 2.ScrubberCasting Plant 3.Cooling and Rectifier Station 4.Carbon Plant	Pneumatic arrangement introduced & Increasing the height of exhausts(4 nos.) in pot room / installed roof monitor / Air side-Loader installed / Thyristor unit installed in place of mercury-arc-rectifier / 5 numbers of wet scrubbers with Bleed-treatment plant / Chlorine-Nitrogen fluxing system provided / Encon burner provided / Cooling tower provided / Bag filter type dust collector 1 no. provided in carbon plant / Thermic fluid heater introduced in place of burner.
Hirakud Power	Electricity- 67.5 MW	1.CFBC Boilers,two numbers, 140 T/hr. 2.CHP& loading un-loading points. 3. Dry ash handling system.	A common stack of 130 m installed, 2 nos. of ESPs with energy meters, Dust extractor & dust supression system provided to control fugitive emissions , Collector in Ash silos with bag filters provision, Facilities for moisturisation in Coal yard and Conditioning of ash, Ash transportation in covered trucks to ash disposal site.
Hirakud Industrial Works	Tower & sub station structures- 7860 TPA	Galvanising unit Oil fired furnace	Exhaust fans (2 nos) to avoid acidic fumes. Adequate stack height
Hira Cable Works	AAC/ACSR Aluminium rods 5000-6000 TPA	Furnace Properzi Plant	Adequate stack height (3 nos). Melting furnace not in operation since installation.One holding furnace operated one at a time.
IDCOL Rolling Mill	Re-rolled products- 14400 TPA	Oil fired furnace	Provided adequate stack height
Rice/Oil Mills	Rice/ Oil	Boilers	Adequate stack height and most of them have provided dust collectors in boilers.
Stone Crushers	Chips/Metals	Jaw Crusher	No Pollution Control Measures

Smelter Unit, INDAL

The Smelter unit of INDAL is producing Aluminium ingot (Capacity 30000 TPA) in obsolete Horizontal -Stud -Soderberg (HSS) process. Wet scrubbing system has been in operation since 1992. The industry has installed 216 pots out of which 210 pots are in operation. The Smelter unit has managed to restrict its fluoride emission within 6 Kg per ton of Aluminium production.

Hirakud Power

Being a small power plant, Hirakud Power has managed to control its emission of Particulate matter within 110 – 120 mg / Nm^3 by installing ESPs. Fugitive emission at coal handling yard and ash transporting areas require constant surveillance. Hirakud Power having one turbine with two boilers of 140 T/hr steam generation capacity has maintained the combustion temperature below 950°C in order to abate generation of Nox and other toxic gases. Provision of adding lime to control high sulphur content in the flue gas is in place.

WATER POLLUTING ACTIVITIES

Unlike other large industries, Power and Smelter plant at Hirakud consume huge quantity of water for various purposes such as cooling, dust suppression system and other industrial uses. The other industries, small and medium categories, also use water in the process. Industries require proper treatment of the waste water being generated from different processes before discharging to outside environment.

Smelter Unit, INDAL

This is an old aluminium smelter plant and till last year about 736 KL of waste water per day was regularly discharged to its captive pond and being recycled into the process. However, the Fluoride content in the Captive Pond was high due to the above discharge. Recently industry has started abandoning its captive Pond which is a great achievement. The industry has separated storm water drain and made provision for the treatment of plant sewage and canteen effluent in its Rotating Bio-logical Contactor (RBC) unit. The treated effluent is being used in the scrubbers. The industry is discharging some part of its colony effluent to the river along with waste water of Municipality through a nallah after treatment. The rest colony effluent is being treated through Vermi-filter.

Hirakud Power

The power plant generates about 961 KL waste water everyday from demineralisation unit (DM), boiler blow down, surface run-off from the coal and ash handling areas which is alkaline in nature. The industry has provided a continuous pH measurement system. The industry was discharging its effluent through an Oil & Grease Trap followed by a settling pits till 1998 and finally the treated effluent was being discharged to the river. But since last year the industry has made arrangement for recycling of entire effluent for the use in different areas in the plant. The industry has disconnected effluent drain which was earlier mixing with Smelter effluent drain.

Other Industries

The medium scale industries present in this area are not water intensive unit as a result of which there is negligible discharge to outside. However, some of them have made arrangement for treatment and recycling arrangement for their effluent generated. There are number of Small Scale industries (SSI) out of which the rice mills and oil mills are generating waste water from par-boiling tank after paddy processing and washing from crude oil processing (showing high content of BOD and Suspended Solids) ultimately flow to various nallahs / streams. However, almost all of them adopted treatment facilities like settling pit followed by filter beds. Regular cleaning and maintenance of these treatment facilities are to be taken on priority basis. Most of the SSI in Industrial Estate, Sambalpur are discharging effluents to IDCO drain without treatment except a few having evaporation tank, pits etc.

Table:VI-3: Water Conservation by Re-utilisation of Power Plant Effluent

SOURCE	QUQNTITY OF EFFLUENT PER DAY		USED IN
Cooling water blowdown	840 KL		Smelter in scrubbers
DM Plant treated & back wash water	25 KL	121 KL	Collected in storage tank and used in coal yard spraying, ash moistening and gardening.
Boiler blow down	72 KL		
Service line	24 KL		

Table:VI-4: Water Pollution Control Measures Adopted by Industries

Name of Industry	Sources	Measures taken
Hirakud Power	1.DM Plant 2.Cooling blow down & 3. washing	Neutralisation pit for DM Plant/Recycling of cooling blow-down / for washing oil & grease trap and series of settling pits.
Smelter Unit, INDAL	1.Domestic 2.Colony sewage 3. Factory wash water & Sewage and cooling tower blow down	1.Septic tank and soak pit. 2.Vermi filter & Vermi compost technology. 3.Treated in RBC unit & scrubber. (Abandoning of Captive pond is on progress.)
Hirakud Industrial Works	1.Domestic water from 2.Factory Wastewater from galvanising unit	1.Soak pits 2.No discharge of effluent to outside. Neutralisation tank followed by series of settling tank. Chemical dosing.
Hira Cable Works	1.Wire draining section & 2.Domestic	1.Oil trap & collection tanks for recycling. 2.Domestic waste to septic tank and soak pit.
IDCOL Rolling Mill	Factory cooling effluent	No discharge to outside . Recycling of cooling water blow-down.
Rice Mills	Parboiling	Settling pits with series of filter beds.

SOLID WASTES GENERATING ACTIVITIES

The solid wastes generated from various industries in Sambalpur town are increasing day by day and need suitable disposal and management. The industrial wastes those are generated may be hazardous and are usually disposed off on land, reused, recycled in the process or sold depending upon their constituents. The disposal of wastes on land may create environmental problems due to leaching, chemical degradation, bio-accumulation and adsorption.

The two sister units of INDAL i.e. Hirakud Power generates most of the industrial wastes in the form of dry fly ash, bottom ash, sludge etc. and Smelter Plant similarly generate spent pot linings, dross and discarded containers of chemicals. Most of them are categorised under hazardous waste. The fly ash generated from Hirakud Power is 146843 MT in 1998 – 99. Hirakud Power has made provision for the collection of dry ash in two silos with conditioning arrangement and has already dumped fly ash in two ash mounts (in 24 acres) providing garland drain and plantations. The dumping of waste is being continued in 14 acres of land for another ash mount with present practice. The industry has made utilisation of the fly ash in cement production, bricks and in construction of roads to some extent. The Smelter unit of INDAL has four numbers of significant dump yards for the dumping of wastes outside the factory premises that are made impervious. The one for the dumping of spent pot lining is filled and has already encapsulated. There are three other impervious lined-pits made for the disposal of scrubber sludge of which one is completely covered with earth and second one is on the verge of completion. These wastes being hazardous, need proper care for their management, transport, storage and disposal.

Apart from above wastes – mill scraps, scales, zinc ash, off specification products and discarded containers etc; those are generated from the medium and small scale industries are mostly sold, used for land filling inside the premises or buried inside the factory premises. The management of husk-ash, which is largely generated from the rice mill, require more attention.

The waste management undertaken by the large scale industries like Hirakud Power & Smelter has improved. However, in order to strengthen waste management INDAL has to give more attentions in transportation of fly ash and care should be taken during disposal of hazardous waste. A comprehensive summery of the present practice of waste management in different industries are given in Table:VI-5. Common disposal facilities may be encouraged for cluster of small scale industries with wastes minimisation facilities and proper awareness.

Table:VI-5: Solid Waste Generating Industries (Large / Medium / Small)

Name of Industry	Name of waste	Source	Qty of Waste	Mode of Disposal
Hirakud Power	Fly ash Bottom ash	Process Furnace	12245.25 T/M, 146943 T/A	Ash mount of 24 acres already vegetation. One more mount of 14 acres.
INDAL (Smelter)	1.Spent Lining 2.Scrubbersludge 3.Al.Dross 4.Discarded containers of chemicals	1.Pot Lining 2.Process 3.Furnace Charged chrome bags	400 T/A 1083 T/A 230 T/A 225585 bags/A	1.Stored in concrete shed for the transportation to Belgaum for recovery of cryolite. 2.Disposed in impervious lined pits. 3.Stored in concrete vat and sold outside. 4.Disposed as such in impervious lined pit
Hirakud Industrial Works	Zinc ash & dross	Process	60.0 T/A	Selling to outside parties
Hira Cable Works	Scraps	Process	Negligible	Selling to outside parties
IDCOL Rolling Mill	Mill Scales & Scraps	Process	303 T/A	Land filling and selling.
Rice Mills(16 nos.)	Husk Ash	Boiler	23556 T/A	Land filling and selling
Gudakhu Factories (5 nos.)	Wastes Tins/ Papers	Packing	20 T/A	Land filling
Miscellaneous (Flour Mill – 3 nos.,medicine-2 nos.,Al utensils etc-4 nos. and Detergent –8 nos.)	Different Wastes		16.16 T / A	Disposed off on land inside premises, selling, off specification products buried inside factory premises

CHAPTER - VII

BIO-DIVERSITY

FOREST COVER

The variety of plants and the animal species present in the natural environment is not only fundamental to the quality of human life but also essential for human survival. Goods & Services such as food, clothing, housing & medicines are derived from diverse biological resources. But due to environmental degradation most of the biodiversity habitats are threatened. The forests of Sambalpur are mostly coming under Northern tropical dry deciduous and moist deciduous forests.

Sambalpur was rich in biodiversity habitats due to the presence of natural forests and the total forest cover in the district was 6342 sq. km (Forest Department, 1981). Gradually the forests are denuded by urbanisation, industrialisation and deforestation (43 of the total forests deforested) which resulted in long term climate change (Mishra & Dash 1984). The forest cover under Sambalpur division was 656.43 sq. km. as on April 1996 and it included 425.87 sq. km of Reserve Forest.

Sambalpur area along with small hills like Budharaja and Motijharan are extension of Eastern Ghat belt. However, Satpura strike is also seen at Laxmidungri hill at its northern side. A Reserve Forest (denuded) in a hillock named Laxmidungri is 6 Kms away from the township of Sambalpur at 21° 44' N latitude & 83° 50' E longtitude. Towards the south of the hill flows the river Mahanadi and to the East passes the N.H.– 6. Hirakud town is situated at the west of the site. The height of the hill ridges varies from 700 feet – 900 feet. One protected forest forming a part of the Barpahad Forest range, Dehri hill is inside Sambalpur University campus at Burla (21° 25' N latitude & 83° 52' E longtitude). It was during the construction of Hirakud Dam large scale denudation occurred. After the establishment of Sambalpur University campus at Burla in 1973, the hill re-generated into a forest under the care & protection of Sambalpur University. Badrama Forest Range which is located at 21° 05' North latitude to 21° 12' N and longtitude 84° 05' E to 84° 13' E and about 22 Kms away from Sambalpur has rich biodiversity.

VEGETATION

Vegetationally Sambalpur region belongs to the Sal (*Shorea robusta*) belt of the Northern India (Champion & Seth 1968). However, there is anomalous occurrence of teak on Laxmidungri which revealed the presence of 31 species of herbaceous vegetations (Table: VII – 1). The hill is slowly recovering (which was denuded during Hirakud Dam Project) with natural re-generation of teak & other species.

Table:VII-1: List of Herbaceous Vegetation at Laxmi Dungri Reserve Forest.

Name of the species

Adiantum caudatum
Ageratum conyzoides
Andographis paniculata
Atylosia scaraboides
Blepharis molluginifolia
Cassia tora
Cleome viscosa
Cyperos rotundus
Cynodon dactylon
Desmodium trifolium
Euphorbia hirta

Name of the species

Evolvuous alsenoides
Heliotropium indicum
Heteropogon contortos
Indigofera pulchetta
Justicia simplex
Leucas aspera
Mimosa pudica
Ocimum basilicum
Ocimum camum
Panicum aicsium
Panicum indicum

Name of the species

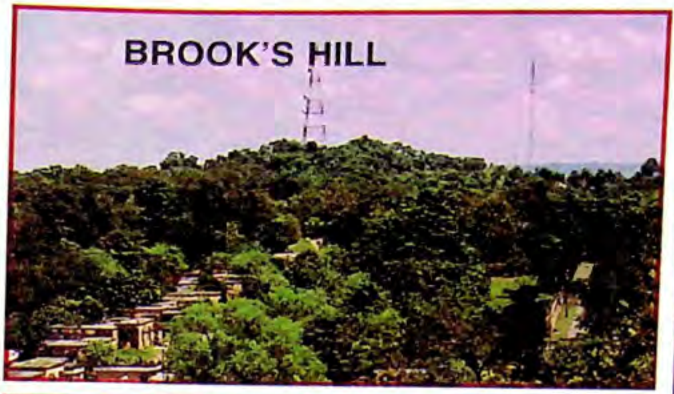
Phyllanthus niruri
Sida cordifolia
Spermacoce hirolda
Tephrosia purpurea
Tridax procumbens
Urena lobata
Pandollia crustacea
Permovia cineria
Zornia diphylla

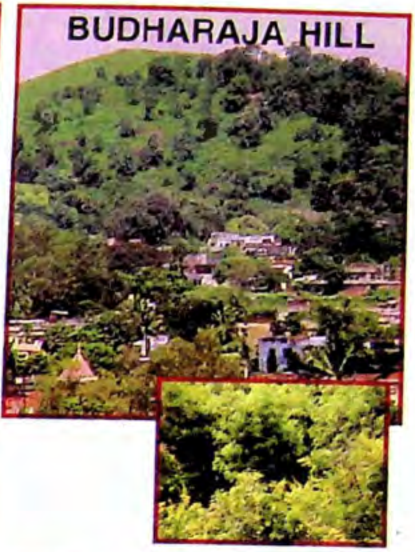
In Badrama Forest Range , forty six plant families with 120 species have been recorded. The dominating families are Combretaceae for trees, Rubiaceae for Shrub, Fabaceae for Liana and Asterceae for herbacious species. The Forest tree vegetation is categorised as *Shorea-Terminalia-Pterocarpus* type with a total density of 944 stems per hectare. Seedling and Sapling analysis indicated mortality of *Shorea robusta* and withdrawl symptoms of *Pterocarpos marsupium* (Devi & Behera 1998). The different vegetation layer is presented in Table: VII – 2.

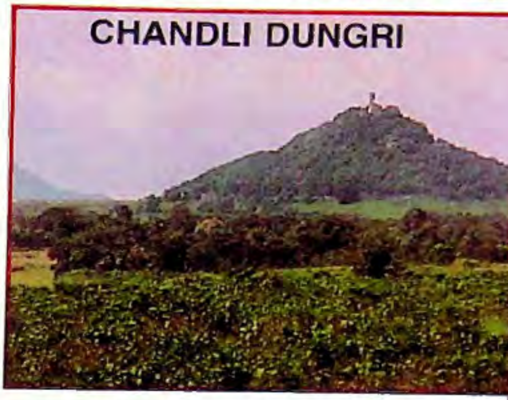
Table: VII - 2 : List of Families for Different Vegetational Layer in Badrama Forest Range

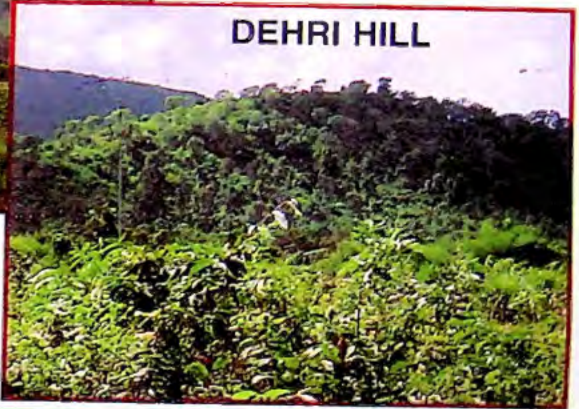
Family	No. of Species
TREES	
Anacardiaceae	4
Bignoiaceae	1
Bixaceae	1
Bombacaceae	1
Bursaraceae	1
Caesalpiniaceae	5
Celastraceae	1
Combretaceae	6
Dipterocarpaceae	1
Ebenaceae	3
Euphorbiaceae	4
Fabaceae	6
Flacourtiaceae	1
Lecythidaceae	1
Lythraceae	1
Meliaceae	2
Mimosaceae	3
Moraceae	1
Myrtaceae	1
Palmae	1
Poaceae	1
Rhamnaceae	1
Rubiaceae	5
Rutaceae	1
Sipandaceae	1
Sapotaceae	1
Sterculiaceae	1
Tiliaceae	1
Verbenaceae	2
SHRUBS	
Acanthaceae	1
Apocyanaceae	1
Euphorbiaceae	2
Fabaceae	2
Flacourtiaceae	1
Lythhraceae	1
Myrsiniaceae	1
LIANAS	
Apocyanaceae	1
Aristolochiaceae	1
Asclepiadaceae	2
Caesalpiniaceae	1
Combretaceae	2
Dioscoreaceae	1
Convolvulaceae	1
Fabaceae	4
Liliaceae	2
Mimosaceae	2
Olacaceae	1
Rhamnaceae	1
HERBS	
Amarillidaceae	1
Areceae	1
Asteraceae	6
Convolvulaceae	1
Cyperaceae	2
Euphorbiaceae	1
Fabaceae	5
Lamiaceae	2
Malvaceae	1
Poaceae	3
Rhamnaceae	1
Zingiberáceae	1

Table: VII-3 shows some information about the medicinal flora and their ecological status in Badrama Forest Range. A study conducted on floristic vegetation in Dehri Hill reveals that *Zizyphus xylocarpa, Diospyros melanoxylon, Cleistanthus collinus, Chloroxylon Swietenia, Helicteris ixora, Holarrhena antidysenterica, Anogeissus latifolia, Buchanania lanzans, Butea monosperma* are more frequently and abundantly observed tree species in the hills (Joshi & Behera, 1990)


BROOK'S HILL


BUDHARAJA HILL


CHANDLI DUNGRI


DEHRI HILL

SELF GENERATED TEAK GROWTH

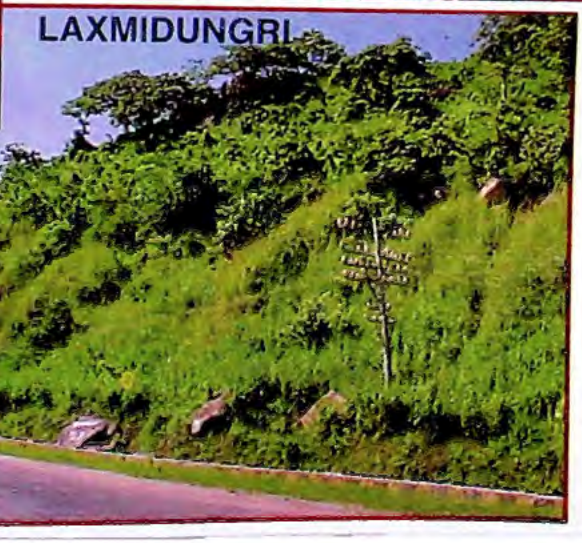

LAXMIDUNGRI

Table: VII - 3 : Medicinal Tree Species of Badrama Forest Range and Their Property

Sl.No	**Tree Species**	**Family**	**Plant parts used**	**Curative property**
01	*Aegle marmelos*	*Rutaceae*	Leaves, fruit, bark	Diabetes, Piles, Digestive trouble
02	*Acacia catechu*	*Mimosaceae*	Leaves, Pods, bark, gum	Boils, Leprosy, Antidote to herbal poison
03	*Albizzias odor attissima*	*Mimosaceae*	Leaves, gum, bark, seed oil	Night blindness, Leucoderma, dental trouble
04	*Albizzia procera*	*Mimosaceae*	Leaves, gum, bark, seed oil	Night blindness, Leucoderma, dental trouble
05	*Anthocephalus kadamba*	*Rubiaceae*	Flower, root, bark	Scabies, Boils, Leprosy, worm treatment
06	*Azadiracta indica*	*Meliaceae*	Entire plant	Skin diseases, Leprosy, Tape worm treatment, Rheumatism
07.	*Bauhinia variegata*	*Caesalpiniaceae*	Root, stem, bark flower	Piles, Thyroid infection, Memory power
08.	*Bombax ceiba*	*Bombacaceae*	Gum bark, flower,fruit	Acne, Pimples, Burns
09.	*Buchanania lanzan*	*Anacardiaceae*	Leaves, fruit, seed, bark.	Seed oil promotes hair growth, dysentery
10.	*Butea monosperma*	*Fabaceae*	Leaves, flower, bark	Diabetic, haemorrhagic
11.	*Careya arborea*	*Lecythidaceae*	Bark, fruit, flower	Ulcers, wounds, snake bite
12.	*Cassia fistula*	*Caesalpiniaceae*	Bar, fruit, pulp, leaves	Constipation, Jaundice, skin disease
13.	*Chloroxylon swietenia*	*Meliaceae*	Bark powder and paste	Chill fever, internal tumor
14.	*Cochlospermum religiosum*	*Bixaceae*	Leaves, gum , seed	cough, swoolen throat, diarrhea
15.	*Dalbergia latifolia*	*Fabaceae*	Leaves, bark, Juice, wood oil	Obesity, leprosy, eczema
16.	*Diospyros melnoxylon*	*Ebenaceae*	Bark, fruit, seed	Ulcers, wound in gums, dysentery
17.	*Elaeodendron glaucum*	*Celastraceae*	Leaves, bark, root	Snake bite, head ache
18.	*Emblica officinalis*	*Euphorbiaceae*	Leaves, fruit, oil	Vitamin C, ulcers, cough & cold, vomiting, night blindness, constipation

19.	*Gardenia latifolia*	*Rubiaceae*	Resinous excretion from fruit	Antiseptic
20.	*Gmelina arborea*	*Verbenaceae*	Root, leaves, fruit, bark	Leaf juice removes maggot from wound
21.	*Holarrhena antidysenterica*	*Apocyanaceae*	Bark, seed	Dysentery, diarrhea, blood disorder
22.	*Madhuca indica Gel.*	*Sapotaceae*	Seed oil, flower juice	Liquor as tonic, seed oil for beauty treatment.
23.	*Morinda tinctoria*	*Rubiaceae*	Root, leaves, fruit	Infantile diarrhea fever
24.	*Pongamia pinnata*	*Fabaceae*	Bark, leaves, tender branch, seed oil	Diabetes, acne, herpes
25.	*Pterocarpus marsupium*	*Fabaceae*	Red gum, heart wood	Tooth ache, diabetes, hair growth acne.
26.	*Semecarpus anacardium*	*Anacardiaceae*	Nut, Kernel, Seed oil	Asthma, Gum trouble, leprosy.
27.	*Schleichera oleosa*	*Sapindaceae*	Bark, aril, seed oil	Acne, hair growth
28.	*Shorea robusta*	*Dipterocarpaceae*	Resin, wood oil, bark	Antifungal, antirheumatic, piles dysentery, diarrhea
29.	*Seymida febrifuga*	*Meliaceae*	Bark	
30.	*Stereospermum suaveolens*	*Bignoniaceae*	Flower, plant ash	High cough, fever, dropsy
31.	*Streblus asper*	*Moraceae*	Latex, leaf juice, bark	Decoction and barkpaste relieves fileria
32.	*Syzygium cumini skeels*	*Myrtaceae*	Leaves, bark, fruit, seed	Ulcerated wound, Blood dysentery, diabetes.
33.	*Tamarindus indicus*	*Caesalpinaceae*	Leaves, bark, flower, fruit, seed.	Vomiting, jaundice, worm infection antidote
34.	*Terminalia arjuna*	*Combretaceae*	Root, bark, fruit	Blood pressure, heart disease
35.	*Terminalia bellerica*	*Combretaceae*	Fruit, seed pulp	Laxative, liver disorder, hair growth
36.	*Terminalia chebula Ritz.*	*Combretaceae*	Fruit, stone of seed	Cough, kidney stone, obesity
37.	*Terminalia tomentosa*	*Combretaceae*	Bark, gum	Diarrhea, ulcer
38.	*Vitex peduncularis*	*Verbenaceae*	Bark	Antidote to malaria
39.	*Zizyphus xylopyrus*	*Rhamnaceae*	Leaves, bark, fruit	Dysentery, fever, obesity, boils, cough, scabies

Budharaja hill is at present in a complete denuded conditions. Investigation on vegetation reveals presence of small patch of phanerophyts. Herbaceous vegetation observed in the hill are presented in Table: VII – 4.

Table: VII - 4 : Herbaceous Vegetation In Budharaja Hill, Sambalpur

TYPE OF SPECIES (Foot hill)	*TYPE OF SPECIES (Slope region)*	*TYPE OF SPECIES (Hill top)*
Andrographis Paniculata	*Andrographis paniculata*	*Cynodon dactylon*
Croton sparciflorus	*Tephrosia indica*	*Eragrostiso viscosa*
Cynodon dactylon	*Atylosia cajanifera*	*Zizyphus jujuba*
Evolvulus elsinoides	*Ocimum canum*	
Justicia simplex	*Rangia perviflora*	
Oldenlandia corymbosa	*Sida cordifolia*	
Sida cordifolia	*Zizyphus jujuba*	
Tephrosia indica		

FAUNAL DIVERSITY

Like flora, faunal diversity is fairly high in this area this invariably depends on the type & abaundants of plants species and plant cover respectively. The other factors namely climate and presence of water bodies also exert influence on the fauna diversity. Attempts were made for preparation of check list of vertebrate fauna only. The most commonly noticed fishes, amphibians, reptiles, birds, mammals etc. are listed in table: VII-5 to 8. The list of fauna has been noted down from field observations as well as inputs from local sources and forest departments.

Table: VII-5: Fishes Fauna

FISHES		
SL.	**COMMON NAME**	**SCIENTIFIC NAME**
01	Catla	*Catla catla*
02	Rohu	*Labeo rohita*
03	Mrigel	*Cirrhina mrigala*
04	Kalbaus / kala bainsi	*Labeo Kalbasu*
05	Putia	*Barbus minor*
06	Magur	*Clarias batrachus*
07	Singi	*Heteropneustis fossilis*
08	Pholui	*Notopterus notopterus*
09	Chital	*Notopterus chitala*
10	Koi	*Anabas testudinus* *(= scandens)*
11	Silver carp.	*Hypophthalmicthys molitrix*
12	Grss carp	*Ctenopharyngodon idella*
13	Boal (Balia)	*Wallago attu*
14	Adi	*Mystus aor*
15	Bata	*Labeo bata*
16	Chang	*Ophicephalus gachua*
17	Soal	*Ophicephalus marutius*
18	Lata	*Ophicephalus puncatu*
19	Mudeel (Kochia)	*Amphipnous cuchia*
20	Gadisa	*Channa sp.*
21	-	*Comast ncembellus*
22	Mahuradi	*Amblypha ryngodon sp.*
23	Patpania	*Chanda ranga*
24	Kantia	*Mustus keletius*
25	Kerandi	*Puntius sophore*
26	Thodi (Spinyeel)	*Mastace mbelus pancalus*

Table: VII- 6: Amphibian Biodiversity

AMPHIBIAN		
SL.	**COMMON NAME**	**SCIENTIFIC NAME**
01	Common Frog (Brahmuni Benga)	*Rana tigrina*
02	Indian Toad (Katakatia Benga)	*Bufo melanostictus*
03	Tree frog	*Polypedates maculatus*
04	Katakatia Benga	*Bufo stomaticus*
05	The Baloon frog	*Microhyla oranta*
06	-	*Ramanella variegata*
07	Gatua Benga	*Uperedon systoma*
08	Gatua Benga	*Tomopterna breviceps*
09	Rice field frog	*Rana limnocharis*
10	Water skipper (Pani Benga)	*Rana cyanophlyctis*

A recent study (Dash & Mahanta,1993) indicates that Rana tigrina occur very sparsely and its population are threatened because of pesticide application , change in land use patterns etc. and require conservation measures.

Table: VII-7: Available Species in Reptiles

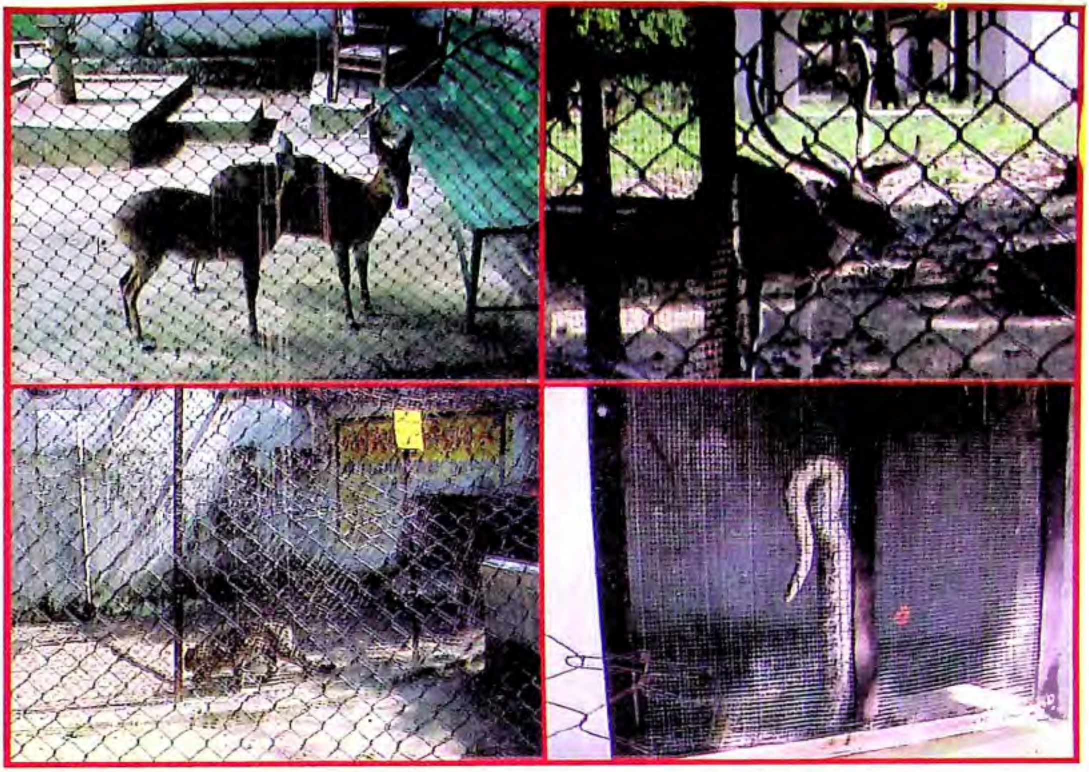
REPTILIA		
SL.	**COMMON NAME**	**SCIENTIFIC NAME**
01	Aendua	*Calotes versicolor*
02	Ajagar	*Python molurus*
03	Ahiraj (King cobra)	*Naja bungarus*
04	Crocodile	*Crocodilus palustris*
05	Gharial	*Gavialis ganeticus*
06	Naga	*Naja tripudians*
07	Chiti	*Bungarus coerulus*
08	Banded krait	*Bungarus fasciatus*
09	Godhi	*Varanus bengalensis*
10	Godhi	*Varanus salvator*
11	Bahurupi	*Chameleon zeylanicus*
12	Dhamena	*Zamenis mucosus*
13	Mati Biradi	*Eryx conicus*
14	Andhuni	*Typhlop sp.*
15	Green whip snake	*Dryophis myctenizan*
16	Fresh Water Turtle	*Lissemys punctata*
17	Fresh Water Turtle	*Chitra indica*
18	Chandan Boda	*Vipera russelli*
19	Flying Lizard	*Darco maculatus*

: These species are threatened as per RED DATA BOOK.

Tabe: VII-8: Birds observed in Undivided Sambalpur District

AVI FAUNA		
SL.	**COMMON NAME**	**SCIENTIFIC NAME**
01	Great Crested Grebe	*Podiceps cristatus*
02	Spotted Billed Pelican or Grey Pelican	*Pelecanus philippensis*
03	Little Cormorant	*Phalacrocorax niger*
04	Little Egret	*Egretta garzetta*
05	Cattle Egret	*Bubulcus ibis*
06	Open Billed Stork	*Anastomusos oscitans*
07	White Ibis	*Threskiornis aethiopica*
08	Spoon Bill	*Platalea leucorodia*
09	Flamingo	*Phoenicopterus roseus*
10	Pintail Duck	*Amas acuta*
11	Bramhiny Duck or Ruddy Shelduck	*Tadorna ferruginea*
12	Bar Headed Goose	*Anser indicus*
13	Eastern Peregrine Falcon	*Falco peregrinus*

14	Brahminy Kite	*Haliaster indus*
15	White Bellied Sea Eagle	*Haliacetus leucogaster*
16	Bengal Vulture	*Gyps bengalensis*
17	Pariah Kite	*Milvus nigrans*
18	Indian Peafowl	*Pavo cristatus*
19	Indian Red Jungle Fowl	*Gallus gallus murghi*
20	Jungle Bush Quail	*Perdicula asiatica*
21	Common Bustard Quail	*Turnix suscitator taigoor*
22	Common Crane	*Grus grus*
23	Indian Purple Moorhen	*Porphyrio porphyrio*
24	Bronze Winged Jacana	*Metopidius indicus*
25	Red Wattled Lapwing	*Vanellus indicus*
26	Painted Snipe	*Rostratula benghalensis*
27	Black Winged Stilt	*Himantopus himantopus*
28	Avocet	*Recurvirostra avosetta*
29	Indian Stone Curlew	*Burhinus oedicnemus*
30	Indian Courser	*Cursarius coromandelicus*
31	Brown Headed Sea Gull	*Larus brunnicephalus*
32	Painted Sandgrouse	*Pterocles indicus indicus*
33	Indian Blue Rock Pigeon	*Columba livia intermedia*
34	Ring Dove	*Streptopelica decaocto*
35	Rose Ringed Parakeet	*Psittacula krameri manillensis*
36	Indian koel, Cuckoo	*Eudynamys scolopacea*
37	Ceylon Pied Crested Cuckoo	*Clamator jabonicus*
38	Crow Pheasant	*Centropus sinensis*
39	Barn Owl	*Tyto alba*
40	Common Indian Nightjar or Indian Little Nightjar	*Caprimulgus asiaticus*
41	House Swift	*Apus affinis*
42	Central Indian Trogon	*Harpactes fasiatus legerli*
43	Pied Kingfisher	*Ceryle rudis*
44	Small Green Bee Eater	*Merops orientalis*
45	Indian Roller or Blue Jay	*Coracias benghalensis*
46	Hoopoe	*Upupa epops*
47	Indian Pied Hornbill	*Anthracoceros malabaricus*
48	Northen Green Barbet	*Megalaima zeylanica caniceps*
49	Brown Crowned Pygmy Woodpecker	*Picoides nanus hardwickii*
50	Indian Pitta	*Pitta brachyura brachyura*
51	Eastern Skylark or Indian Small Skylark	*Alauda gulgula gulgula*
52	Common Swallow	*Hirundo rustica*
53	Rufous Backed Shrike	*Lanius schach tricolor*
54	South Indian Black Headed Oriole or Black Headed Oriole	*Oriolus xanthornus maderaspata*



ANIMALS AT DEER PARK
SAMBLAPUR

VEGETATION

55	Black Drongo	*Dicrurus adsimilis*
56	Ashy Swallow Shrike	*Artamus fuscus*
57	Indian Myna or Common Myna	*Acridotheres tristis*
58	Indian House Crow	*Corvus splendens*
59	Indian Tree Pie	*Dendrocitta Vegabunda*
60	East Indian Scarlet Minivet	*Pericrocotus flammeus semiruber*
61	Central Indian Iora	*Aegithina tipha humei*
62	Orissan Redvented Bulbul	*Pycnonotus cafer wetmorei*
63	Orissa Jungle Babbler	*Turdoides striatus*
64	White Throated Fantailed Flycatcher	*Rhipidura albicollis orissae*
65	Indian Tailor Bird	*Orthotomus sutorius*
66	Pied Bushchat	*Saxicola caprate*
67	Eastern Black Red Start	*Phoenicurus ochruros*
68	Indian Grey Tit	*Parus major*
69	Easternghat Chestnutbellied Nuthatch	*Sitta castanea prateri*
70	Indian Paddyfield Pipit	*Anthus novaeseelandiae rufulus*
71	Indian Thickbilled Flower Pecker	*Dicaeum agile agile*
72	Indian Purple Sunbird	*Nectarinia asiatica asiatica*
73	Indian White Eye	*Zosterops palpebrosa palpebrosa*
74	Indian House Sparrow	*Passer domesticus indicus*
75	Indian Baya	*Ploceus philippinus philippinus*

Table: VII-9: Mammals Diversity

MAMMALIA

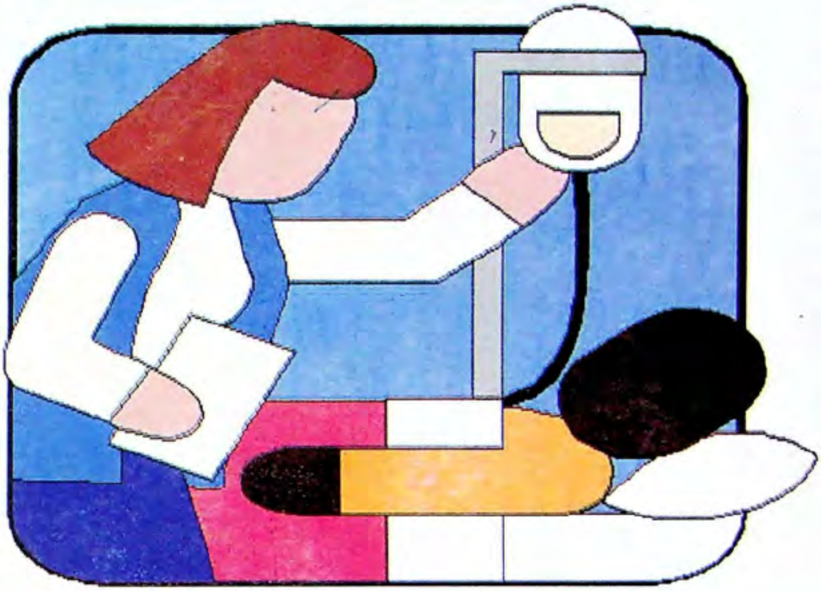
SL.	COMMON NAME	SCIENTIFIC NAME
01	Squirrel	*Funumbalus pennanti*
02	Squirrel	*Funumbalus palmarum*
03	Sheep	*Ovius polic*
04	Cow	*Bos indicus*
05	Buffalo	*Bubalus indicus*
06	Pig	*Sus cristatus*
07	Cat	*Felis domesticus*
08	Dog	*Canis familiaris*
09	Goat	*Capra hircus*
10	Horse	*Equus cabalus*
11	Ass	*Equus hemionus*
12	Elephant	*Elephas indicus(=maximus)*
13	Mongoose	*Herpestis edwardsi*
14	Mongoose	*Herpestis auropuntata*

15	Musa	*Rattus rattus*
16	Musa	*Mus musculus*
17	Hare	*Lepus nigriculis*
18	Bat	*Ptreropus gigantus*
19	Bat	*Reusetus beschnaulti*
20	Bat	*Cynopterus spihis*
21	Jackal	*Canisla latrans*
22	Bagha (Tiger)	*Panthera tigris*
23	Leopard	*Panthera pardus*
24	Wolf	*Canis lepus*
25	Stripped Hyena	*Hyaena striata*
26	Fox	*Valpes bengalensis*
27	Chuchundra	*Suncusn caeruleus*
28	Odha	*Lutra lutra*
29	Rhesus mscque	*Maccaca mulata*
30	Hanuman	*Prespytis entellus*
31	Sambar	*Cercus unicolor*
32	Bhalu (Bear)	*Ursus ursinus*

Table: VII -10 : Captive Animals Available In Motijharan Deer Park Sambalpur

SL.	COMMON NAME	SCIENTIFIC NAME	NUMBER OF ANIMALS
1	Spotted deer	*Axis axis*	38
2	Blue bull	*Boselaphus tragocamelus*	1
3	Black buck	*Antilope cervicapra*	2
4	Four horn antelope	*Tetracerus quadricornis*	2
5	Leopard	*Panthera pardus*	1
6	Sloth beer	*Melursus ursinus*	2
7	Pangolin	*Manis crassiclaudata*	1
8	Ajagar	*Python molurus*	1

CHAPTER - VIII



HEALTH STATUS

HEALTH PROFILE

Many diseases are caused due to the hazards present in the surrounding environment. Detailed data from different Hospitals, Dispensaries and Nursing homes in the study area have been collected with regard to the types of patients admitted for treatment. The objective of the exercise was to find out the main health hazards and their connection with the natural environment. One may suffer either from water borne or air borne diseases. It is revealed from the study that water borne diseases are dominant in this area.

The Patient Admission Book Record of Headquarter Hospital, Sambalpur indicated 72372, 34773, 28746 numbers of patients were admitted due to Enteric Colitis & Gastro-enteritis, acute Diarrhea, Amoebic dysentery respectively during the period from 1994-1999. Similarly, Medical College Hospital, Burla recorded cases of Enteritis (both Colitis and Gastric), Amoebic dysentery and Typhoid fever to the tune of 14776, 10000 and 3807 respectively from 1993-1998. It is clearly seen that the two major hospitals in the area recorded maximum number of patients suffering from infection of Colitis and Gastro-enteritis which are water-borne in nature. The other two dominant diseases encountered in the area are also water-borne diseases.

Table: VIII-1: Patients Admission Record

Name of Diseases/ Category of Patients	Headquarter Hospital,Sambalpur					Medical College Hospital, Burla				
	94-95	95-96	96-97	97-98	98-99	93-94	94-95	95-96	96-97	97-98
Typhoid Fever	292	211	567	227	2221	593	415	679	1340	780
Food Poisoning	-	39	40	-	-	40	8	8	15	41
Amoebic dysentery	6921	7711	8735	3937	1442	2712	1721	3695	940	932
Colitis & Gastro-Enteritis	5736	17679	11070	18536	19351	4336	3368	2729	2357	1976
Viral Hepatitis	143	77	120	78	42	430	403	436	490	470
Diarrhea	9005	6406	6650	6185	6527	970	576	330	-	18
Paratyphoid Fever	-	-	-	-	-	50	90	8	29	-
Poliomyelitis	-	-	-	-	-	56	48	10	-	-

WATER BORNE DISEASES

Water borne diseases are caused by contamination of water. These diseases are transmitted to others by the use of filthy, polluted and contaminated water raised from domestic and other uses in the form of fluid water, foot soil, finger, food, flies etc.

Infectious diseases are caused by pathogenic bacteria, viruses and protozoa or by parasites. Gastro-enteritis is transmitted primarily through human excreta; particularly faeces. E.Coli which is a pathogen is abundantly present in human and animal faeces.

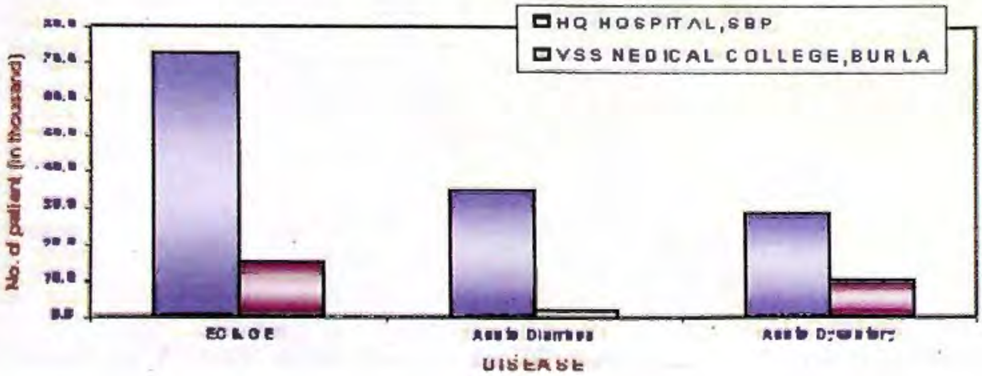
Table:VIII-2 : Classification of Water Borne Diseases

INFECTIVE AGENTS	DISEASES	CARRIERS
Bacterial Agents	Typhoid Fever Paratyphoid Fever Bacillary Dysentery Food Poisoning Colitis & Gastro Entertitis Cholera	Salmonlla typhi Salmonlla paratyphi Shigella Salmonlla enteritidis Escherichia coli & Rotavirus Vibrio-cholera
Viral Agents	Poliomyelities Hepatitis-A Hepatitis-C Hepatitis-E	Enterovirus Hepatitis virus
Protozoal Agents	Amoebiasis	Entamoeba hystolytica

Orissa Voluntary Health Association in its Report " Status of Health in Orissa, 1995 " reported about the the disease i.e Gastro-enteritis as an emerging problem in Sambalpur District. In order to improve the existing health situation the focus should be given on the areas

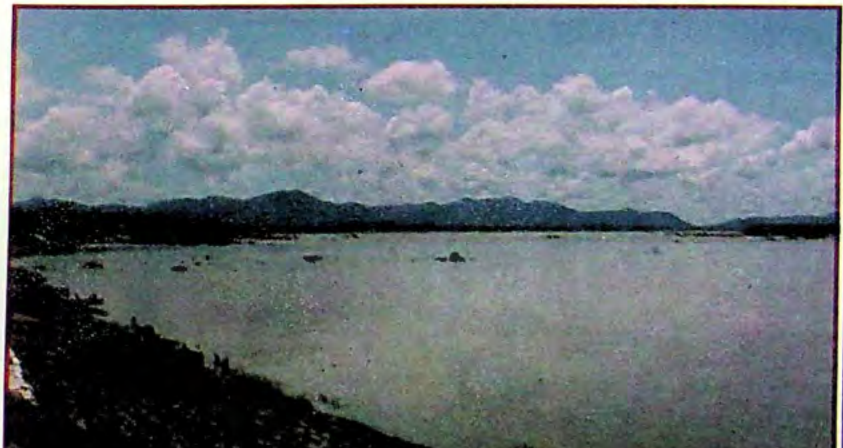
- Ensure Food Security
- Ensure Safe water Supply
- Ensure Sanitation
- Ensure Effective Utilisation of Health Services
- Reviving Traditional System of Medicines
- Effective Implementation of National Health Programme

DISEASE RECORD



CONCLUSION & RECOMMENDATION

CHAPTER - IX



CONCLUSION & RECOMMENDATION :

Sambalpur and its surrounding have been growing fast due to rapid urbanisation and to some extent industrialization in the last two decades. This has resulted in environmental degradation with regard to water, air, soil quality and increased noise level . As such the present status is not so alarming. If proper management has not been followed to restrict activities of rural-urban migration, emerging pollution etc. ; then things will go out of hands in no time.

Rapid growth in population resulting in increased population density and demand for more housing has been considered as a major problem in the town . Its manifestation has been quite conspicuous in the fields of health , sanitation, water supply, sewage disposal , noise and solid waste management, resource utilisation etc.Perceived climatic change is nevertheless a recent cause of concern.

The town is influenced largely by agrarian economy. As a result around 70% are non workers, which clearly determines the socio-economic conditions have not yet been improved. A clear but slow shift towards industrial economy has been observed in the recent times. Such a change should be well planned to ensure positive development.

In Sambalpur, the absence of a reliable and efficient public transport system has encouraged the growth of personal transport facilities in general and two & three wheeler automobiles in particular. Since these vehicles are largely air polluting in nature, timely steps may be taken to facilitate smooth traffic flow and to discourage the rapidly increasing trend in personal transport facility. As revealed from the Air Quality Index (AQI) the natural air environment was found to be fairly clean. To maintain such quality; authorities should plan carefully, considering the Zoning Atlas of the area for better allocation of space for residential , commercial and industrial activities.

The overall noise level within the study area was within prescribed limits. But, noise generated from the vehicles was observed to be high during peak hours (09.00hr – 12.00) in most of the nodes ; which is largely due to the use of pressure horns by the vehicles, congestion due to narrow roads , at places bad road conditions , closely-knitted houses with limited open space etc.

There has been no organised drainage and sewerage system in the study area. No treatment is given to the sewage before its discharge into the river Mahanadi resulting in deteriorating water quality of the river. Similar is the condition of the ponds located throughout the area. Ever increasing anthropogenic activities have rendered these water bodies unsuitable for the designated uses. The local authorities and the State government may come out with suitable plans to deal with the situation and to improve the water quality.

Disposal of solid wastes and medical wastes have become a real problem in this area. The local authorities should take adequate steps for the proper disposal and reutilisation of these wastes.

IMPORTANT SUGESTION:

- Town planning authority should consider ***Zoning Atlas*** of this area in future planning.
- Burning of fossil fuel in open and in chullahs should be discouraged and programme to be launched to create awareness among the public for efficient utilisation of these resources.
- While planning the Administration should carefully consider on utilisation of undeveloped land mass. Recreational facilities and open grounds as breathing spaces should be given priority.
- Administration should introduce wider road, controlled traffic system and adequate avenue plantation to overcome dust nuisance in busy areas.
- The provision of obtaining the "***POLLUTION UNDER CONTROL***" certificate to the users should be strictly enforced by the concerned authorities and necessary vigilance check should also be made on their performance.
- Adequate Public transport systems should be introduced.
- Pressure horn should be banned to avoid extra noise being emitted from the vehicles.
- Stone crushers in Remed area should be shifted to suitable locations.
- Public address systems / loudspeakers should not be allowed to play beyond prescribed hours.
- In mining areas dust supression systems and thick vegetation should be maintained.
- Mining activities should not be encouraged in ecologically sensitive areas like Ushakothi Sanctuary.
- A carrying capacity study keeping the supportive and assimilative capacity of the area should be carried out on priority basis.
- Traffic volume may be reduced by diversion of traffic from the busy roads and by providing parking facilities for vehicles in earmarked area.
- Urban local bodies should immediately initiate action plan for treatment of sewage before discharging the same into the River. Proper drainage schemes should be implemented.
- Open defecation should have been stopped on the banks of river & ponds and by the side of the roads.
- Ponds should be renovated and made suitable for designated uses.
- Separate Bins for different garbage and solidwaste should be provided in each ward to avoid improper disposal of wastes.
- Local bodies should implement vermi-composting technology for organic solid wastes.
- Hazardous as well as Bio-medical wastes wherever generated should be disposed off as per appropriate practice.
- Awareness should be created for construction of houses with adequate open space, proper drainage systems, implementation of septic latrines and methods for satisfactory disposal of garbage and other wastes.

REFERENCES:

1. *District Statistical Handbook,1995 (Sambalpur)* ,Directorate of Economics & Statistics, Orissa
2. *District at a Glance,Orissa(1997-99),* Directorate of Economics & Statistics, Orissa
3. *Master Plan of Sambalpur* , Town Planning Authority, Sambalpur
4. *Master Plan of Hirakud* , Town Planning Authority, Sambalpur
5. *Master Plan of Burla* , Town Planning Authority, Sambalpur
6. *Status of Health in Orissa , 1995* ,Orissa Voluntary Health Association ,Dec-1995
7. *Industry Specific Pollution Control Status in Problem Areas - Korba, Chembur, Angul-Talcher, Vizag* , Vol-I, CPCB , August,1994
8. *Practical Handbook on Public Health Engineering* , Er.G.S.Bajwa , 1998
9. *Environmental Status Report - 1996*, Environmental Planning & Coordination Organisation, Bhopal, Madyapradesh
10. *Ambient Air Quality Status of Some Cities/ Towns in India*, CPCB, N.Delhi 1990
11. *Vehicular Air Pollution in Delhi*, CPCB, 1982-83
12. *Vehicular Pollution* , OPCB , 1996
13. *Vehicular Traffic Noise on National & State Highways – A case Study* : A.K.Pal , S.K.Ghosh, T.K.Sinha & N.C.Saxena , CME, ISM , Dhanbad , Minetech vol-18 no 5& 6 Page 15 – 23, 1997
14. *Vehicular Pollution in Calcutta & Air Quality Models* : S.K.Chakrabarty & S.Ganguly, Journal of IPHE, India,Vol-I 1994 ,No 4.
15. *Noise Pollution* , OPCB, June 1996
16. *Noise Level in Metro-politan Cities* ,Part – VI, Hyderabad, CPCB ,N.Delhi, 1991
17. *Standard Methods for the Examination of Water & Wastewater* , APHA - AWWA - WPCF, 1989 (17th Edition)
18. *Water Year Book (Integrated), June 1988 – May 1989 ,Mahanadi & Adjacent River Basins* , Central Water Commision , February 1991
19. *Groundwater Quality in Problem Areas – A Status Report (Part-I & III)* , CPCB, Dec 1995
20. *Water Resources, (State of Environment in Orissa – I),* SPCB, Orissa) , Dr.R.C.Das
21. *Manual on Sewarage & Sewage Treatment (2nd Edition)* ,Central Public Health & Environmental Engineering Organisation , Ministry of Urban Development,N.Delhi , Dec 1993
22. *Pollution Load & Water Quality of Mahanadi Water Systems (Final Technical Report)*, Prof R.C.Das & Prof M.C.Dash , 1986

23. *Proceedings of the Symposium on Environmental Aspects of Water Resources of Orissa*, OPCB ,Orissa ,1988
24. *India's Water Wealth its Assessment, Uses & Projection* , Er.K.L.Rao , 1979
25. *Pollution Load in Taladanda Canal*, OPCB, Orissa, 1990
26. *Pollution load in some Temple Ponds of Orissa*, OPCB, Orissa, 1990
27. *The Brahmani Baitarani Basin* , Report.of the Irrigation Commission, 1972 (Vol-III Part-2),
28. *Report on Survey of Urban Solid wastes of Sambalpur City* (OPCB Publication), CRESD,Bhubaneswar, 1997
29. *Biodiversity at BARC*, Trombey , V.Abrham, BARC, Mumbai , 1998
30. *Biodiversity Conservation : Problems & Prospects*, Edited by Dr H.K.Patra
31. *Phytosociological Analysis of Budharaja Hill Forest*, M.Phil Dissertation submitted by Mrs B.P.Behera, Dept of Botany, G.M.College ,Sambalpur, 1995
32. *Medicinal Flora & its Status in Badrama Forest Range of Sambalpur*, Uma Devi & N.Behera , J. Ecobiol 10(3) ,165-171, 1998
33. *Plant Diversity Assessment in the Badrama Forest Range of Western Orissa*, Uma Devi & N.Behera , J. Biodiversity Conservation : Problems and Prospects, Page no 81- 90,1998
34. *Primary Production of Harbaceous Layer in Tropical Deciduous Forest in Orissa*, India, S.K.Joshi, D.P.Pati & N.Behera , J. Tropical Ecology 31(2): 73-83,1990
35. *Qualitative analysis of Vegetation from a Mixed Tropical Forest of Orissa, India* , S.K. Joshi & N.Behera, J. Indian Forester, 200-206 ,1991
36. *Qualitative analysis of vegetation from a Regenerating Teak Forest of Orissa*, S.L.Swain & N.Behera , J. ECOBIOL 10(!) 13-18,1998
37. *Qualitative Analysis of Herbaceous Vegetation in a Regenerating Teak Forest Floor from Orissa* , S.L.Swain & N.Behera, J.ECOBIOL 8(3) 201 – 207 ,1996
38. *Quatitative analysis of the Community Structure of Tropical Amphibian Assblages and its Significance*, Madhab C.Dash and J.K.Mahanta, J.Bio sci. , 18 :121-129 , 1993
39. *Fundamentals of Ecology*, Tata - McGraw Hill Publi.,N.Delhi, 373 p , V th reprint , M.C.Dash, 1999
40. *Status of Shorea Robusta & Pterocarpus marsupium in a Tropical Dry Deciduous Forest of Orissa*, Uma Devi & N.Behera, j. Science & Technology, Sambalpur University, Vol ugXI,Section -A , 18-22,1999
41. *Bird Watching Book (in Oriya)* ,OECS , Jyoti Vihar , Burla , 92p , 1999